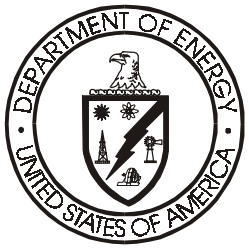
DOE/EA - 1292

ENVIRONMENTAL ASSESSMENT and FINDING OF NO SIGNIFICANT IMPACT

On-Site Treatment of Low Level Mixed Waste

U.S. Department of Energy
Rocky Flats Field Office
Golden, Colorado



March 1999

U. S. DEPARTMENT OF ENERGY

FINDING OF NO SIGNIFICANT IMPACT

ON-SITE TREATMENT OF LOW LEVEL MIXED WASTE AT ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

SUMMARY: The Department of Energy (DOE) has prepared an environmental assessment (EA) (DOE/EA-1292) to evaluate the proposed treatment of low level mixed waste (LLMW) at the Rocky Flats Environmental Technology Site (Site). The purpose of the action is to treat LLMW in order to meet the Land Disposal Restrictions specified by the Resource Conservation and Recovery Act and the waste acceptance criteria of the planned disposal site(s).

Approximately 17,000 cubic meters (m^3) of LLMW are currently stored at the Site. Another 65,000 m^3 of LLMW are likely to be generated by Site closure activities (a total of 82,000 m^3 of LLMW). About 35,000 m^3 can be directly disposed of off-site without treatment, and most of the remaining 47,000 m^3 of LLMW can be treated at off-site treatment, storage, and disposal facilities. However, some LLMW will require treatment on-site, either because it does not meet shipping requirements or because off-site treatment is not available for these particular types of LLMW. Currently, this LLMW is stored at the Site pending the development and implementation of effective treatment processes. The Site needs to treat this LLMW on-site prior to shipment to off-site disposal facilities, in order to meet the DOE long-term objective of clean up and closure of the Site. All on-site treatment of LLMW would comply with applicable Federal and State laws designed to protect public health and safety and to enhance protection of the environment.

The EA describes and analyzes the environmental effects of the proposed action (using ten mobile treatment processes to treat waste on-site), and the alternatives of treating waste on-site (using two fixed treatment processes), and of taking no action. The EA was the subject of a public comment period from February 3 to 24, 1999. No written or other comments regarding the EA were received.

PROPOSED ACTION: The proposed action is to treat certain LLMW on-site, prior to shipment off-site for disposal, using one or more of the ten potential treatment processes for LLMW. About 2,500 to 5,200 m^3 of LLMW may require on-site treatment. This estimate may change as LLMW streams are better characterized, and as additional off-site treatment capabilities become available. The wastes are stored throughout the industrial portion of the Site in various containers (e.g., wooden crates, 55-gallon drums, plastic bags, vials).

Depending upon the waste type, treatment may include one or more of the following processes:

- stabilization/immobilization-polymer macroencapsulation,
- stabilization/immobilization-polymer microencapsulation,
- stabilization/immobilization-cementation,
- neutralization,

- destruction-alkaline chlorination of cyanides,
- destruction-ultraviolet (UV) oxidation,
- separation/decontamination–supercritical CO_2 extraction,
- separation/decontamination–low temperature thermal desorption,
- separation/decontamination–catalyzed chemical oxidation, and
- surface decontamination.

These treatment processes are established processes, which have been used or approved for use at the Site or have been successfully used in similar applications for similar wastes. Most of the proposed treatment processes would be deployed on mobile, skid-mounted units, and could be moved from location to location. Some wastes may be moved from one on-site location to another on-site location for treatment. Wastes would be unpacked, treated, and packaged as necessary (typically a 55-gallon drum would be used). After packaging, the containers would be sent to an approved storage area pending disposal. Construction associated with the proposed action would occur within existing buildings at the Site and would not require substantial additions to Site buildings or utilities. New air monitors, air filters, water lines, and electrical connections may be needed at some of the facilities that would be used to house a process. One or more of the processes would be used to treat a specific LLMW stream.

ALTERNATIVES CONSIDERED: DOE considered but dismissed using two treatment processes, fluidized bed incineration (FBI) and microwave solidification, that would require a stationary on-site location for treating LLMW.

Because the FBI and microwave solidification treatment processes would be permanently situated, additional handling and transport of the waste would be required.

The use of the FBI would require obtaining an air quality permit from the Colorado Department of Public Health and Environment (CDPHE); the microwave solidification treatment process may require an air quality permit. The type of permit would depend on various factors (e.g., regional air quality) and the potential to emit various air pollutants, but the permit application would be subject to a public review. Obtaining a permit would likely take six months to two years. These treatment processes have often generated extensive public opposition, which would further delay the process. Purchasing, constructing, and testing the selected process would take additional time.

The timely use of FBI and microwave solidification is considered impractical for the Site. The use of these processes would likely delay treatment of LLMW, thereby affecting the Site's ability to meet the accelerated off-site shipment schedule required by the Rocky Flats Cleanup Agreement. In addition, implementation of these processes would likely result in greater environmental impacts. For these reasons, this alternative has been eliminated from further consideration.

DOE also considered a No Action alternative. If no action were to be taken, the LLMW streams addressed in this EA would not be treated, and would not be shipped off-site. The No Action alternative would require long-term or permanent storage of some LLMW at the Site.

Existing facilities could be used for storage as long as each facility remained in suitable condition. Some consolidation of wastes at a single facility would be expected. Ongoing programs to clean up the Site would continue under the No Action alternative, but some programs might be delayed or otherwise

modified. The continued generation of LLMW and storage of LLMW could interfere with activities to clean up various facilities at the Site. The Site would need to continue and expand on-site waste management activities; such as inspections and replacement of containers showing signs of severe rusting, apparent structural defects, or leakage.

Implementation of the No Action alternative would raise safety concerns and place the Site in non-conformance with the Settlement Agreement and Compliance Order on Consent No. 93-04-23-01 issued by the CDPHE. Selection of the No Action alternative would also limit future uses of portions of the Site, and impede progress toward achieving the Site's mission of cleanup and closure.

ENVIRONMENTAL EFFECTS: Most potential environmental effects will be minor and temporary. The proposed action will generate criteria and other air pollutants below levels of concern. Radiological impacts will be well below federal standards for workers and the public. There will be no direct effects on water resources from installing and using any of the treatment processes. The chance for a spill during the on-site transport of LLMW is slight, and could be mitigated through existing Site procedures. Impacts to cultural resources can be mitigated through established processes.

Waste management will benefit from implementation of the proposed action. Preparing LLMW for off-site disposition will assist waste management and provide for better control of wastes, and support the Site's closure goals.

Under the No Action alternative, potential environmental effects to air quality, human health and safety, water resources, and cultural resources would be minor and temporary. However, the No Action alternative would not change the existing waste management situation, and continued storage of LLMW in multiple locations at the Site could impede the demolition of Site buildings and closure of the Site. The additional LLMW handling and storage needs, which would occur as buildings are demolished, would adversely affect waste management.

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DETERMINATION: Based on the information and analyses in the EA, DOE has determined that the proposed action to use the listed treatment processes at the Rocky Flats Environmental Technology Site does not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act of 1969, as amended. Therefore, an environmental impact statement is not required, and DOE is issuing this Finding of No Significant Impact for the proposed action.

Signed at Golden, Colorado, this 22 day of March, 1999.

Jessie Roberson

Jessie M. Roberson
Rocky Flats Field Office
U. S. Department of Energy

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ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
AQM	Air Quality Management
As	arsenic
Be	beryllium
CCl4	carbon tetrachloride
CCR	Colorado Code of Regulations
Cd	cadmium
CEQ	Council on Environmental Quality
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
Ci/yr	Curies/year
CID	Rocky Flats Cumulative Impacts Document
C-N	carbon-nitrogen
COE	U.S. Army Corps of Engineers
Cr	chromium
DOE	U.S. Department of Energy
EA	environmental assessment
EDE	effective dose equivalent
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FBI	fluidized bed incineration
FONSI	Finding of No Significant Impact
g	gram
GAC	granulated activated charcoal
gal/lb	gallons/pound
HAP	hazardous air pollutant
HASP	Health and Safety Plan
HEPA	high efficiency particulate air
Hg	mercury
kg	kilogram
L	liters
lb	pound
lb/gal	pounds/gallon
lb/yr	pounds/year

LDR	Land Disposal Restrictions
LLMW	low level mixed waste
m^3	cubic meters
MEI	maximally exposed individual
MEK	methyl ethyl ketone (2-butanone)
mph	miles per hour
mrem/yr	millirem per year
nCi/g	nanocuries per gram
NEPA	National Environmental Policy Act of 1969
NOx	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
Pb	lead
PEL	permissible exposure limit
Plan	Comprehensive Treatment and Management Plan
PM10	particulate matter smaller than ten microns in diameter
PPE	personal protective equipment
PPM	parts per million
PPMV	parts per million by volume
PSD	Prevention of Significant Deterioration
PSTP	Proposed Site Treatment Plan
Pu-239	plutonium-239
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
Region	Metropolitan Denver Intrastate Air Quality Control Region No. 36
Site	Rocky Flats Environmental Technology Site
STP	Site Treatment Plan
TSD	treatment, storage, and disposal facility
U.S.C.	United States Code
VOC	volatile organic compound
WIPP	Waste Isolation Pilot Plant
yr	year

1.0 INTRODUCTION

This Environmental Assessment (EA) has been prepared in compliance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C 4321-4370d), the Council on Environmental Quality (CEQ) regulations implementing the procedural provisions of NEPA (40 CFR 1500-1508), and the Department of Energy (DOE) regulations for implementing NEPA (10 CFR 1021). The purpose of the EA is to provide DOE with sufficient information to determine whether a Finding of No Significant Impact (FONSI) is supported for the proposed action or whether an Environmental Impact Statement (EIS) must be prepared.

1.1 Background

The Rocky Flats Environmental Technology Site (Site), previously known as the DOE's Rocky Flats Plant, is to be cleaned up and closed down. The Site is located in rural Jefferson County, about 16 miles northwest of Denver, Colorado, as shown in Figure 1-1. The Site covers 6,266 acres of land, most of which is an undeveloped buffer zone. The buffer zone wraps around a 384-acre industrial area, which contains the Site's facilities. The facilities and buffer zone are shown in Figure 1-2.

The Site operated from 1952 to 1989, producing components for nuclear weapons. During that time, numerous waste products were generated; many of which remain at the Site today. The current mission is to clean up and close down the Site. Current plans for Site closure include removing all wastes from the Site and disposing of them at off-site facilities.

This EA describes the proposed treatment of one of the largest categories of waste at the Site; low level mixed waste (LLMW). LLMW is defined as any waste that contains transuranic radioactive contaminants (not exceeding 100 nanocuries per gram), and that also contains nonradioactive hazardous constituents or that exhibits a hazardous characteristic regulated under the Resource Conservation and Recovery Act (RCRA). A typical LLMW stream might include used personal protective equipment (PPE), gloves, Kim-wipes, and similar materials, which are contaminated with solvents and have low levels of transuranic contamination. Treatment is defined as any method or process designed to change the physical, chemical, or biological character or composition of LLMW to render the waste safer for storage, transport, or disposal.

DOE was required by RCRA, as amended by the Federal Facility Compliance Act, to submit Site Treatment Plans for all facilities that generate or store LLMW. Accordingly, the Site developed a *Comprehensive Treatment and Management Plan* (Plan). The Plan describes programs and schedules to identify, develop, and implement processes and systems on-site, for the treatment of LLMW generated or stored at the Site (DOE, 1994). The Plan was presented to the Colorado Department of Public Health and Environment (CDPHE), and was subsequently modified in the *Proposed Site Treatment Plan* (PSTP). DOE and CDPHE signed an agreement on October 3, 1995, Compliance Order No. 95-10-03-01, that required DOE to comply with the PSTP. The compliance order also modified the PSTP, which became known as the *Site Treatment Plan* (STP) Baseline, to reflect the development and

construction of new treatment options. In general, the STP Baseline emphasized the use of large, costly, on-site treatment systems.

The STP Baseline was later revised (becoming the STP Rebaseline) when new, accelerated Site closure priorities were identified. The STP Rebaseline focused on off-site waste treatment, whenever possible, to avoid constructing new treatment facilities and establishing new capabilities at a site that is being closed. For the same reasons, the Rebaseline also focused on the use of on-site mobile equipment to treat LLMW that could not be readily shipped off-site for treatment in compliance with the Rebaseline's treatment schedules. The STP Rebaseline was approved on June 17, 1997.

1.2 Purpose And Need

The purpose of the action is to treat LLMW in order to meet the Land Disposal Restrictions (LDR) specified by RCRA and the waste acceptance criteria of the planned disposal site(s).

About 17,000 cubic meters (m3) of LLMW are currently stored at the Site. Another 65,000 m3 of LLMW are likely to be generated by Site closure activities (a total of 82,000 m3 of LLMW). An estimated 35,000 m3 can be directly disposed of off-site without treatment, leaving about 47,000 m3 of LLMW to be treated prior to disposal. Most of the 47,000 m3 can, in fact, be treated at off-site treatment, storage, and disposal (TSD) facilities. However, some of the LLMW will require treatment on-site, either because it does not meet shipping requirements or, in some cases, because off-site treatment is not currently available for these particular types of LLMW. Currently, this LLMW is stored at the Site pending the development and implementation of effective treatment processes.

The Site needs to treat this LLMW on-site prior to shipment to off-site disposal facilities, in order to meet the DOE long-term objective of clean up and closure of the Site. All on-site treatment of LLMW would comply with applicable Federal and State laws designed to protect public health and safety and to enhance protection of the environment.

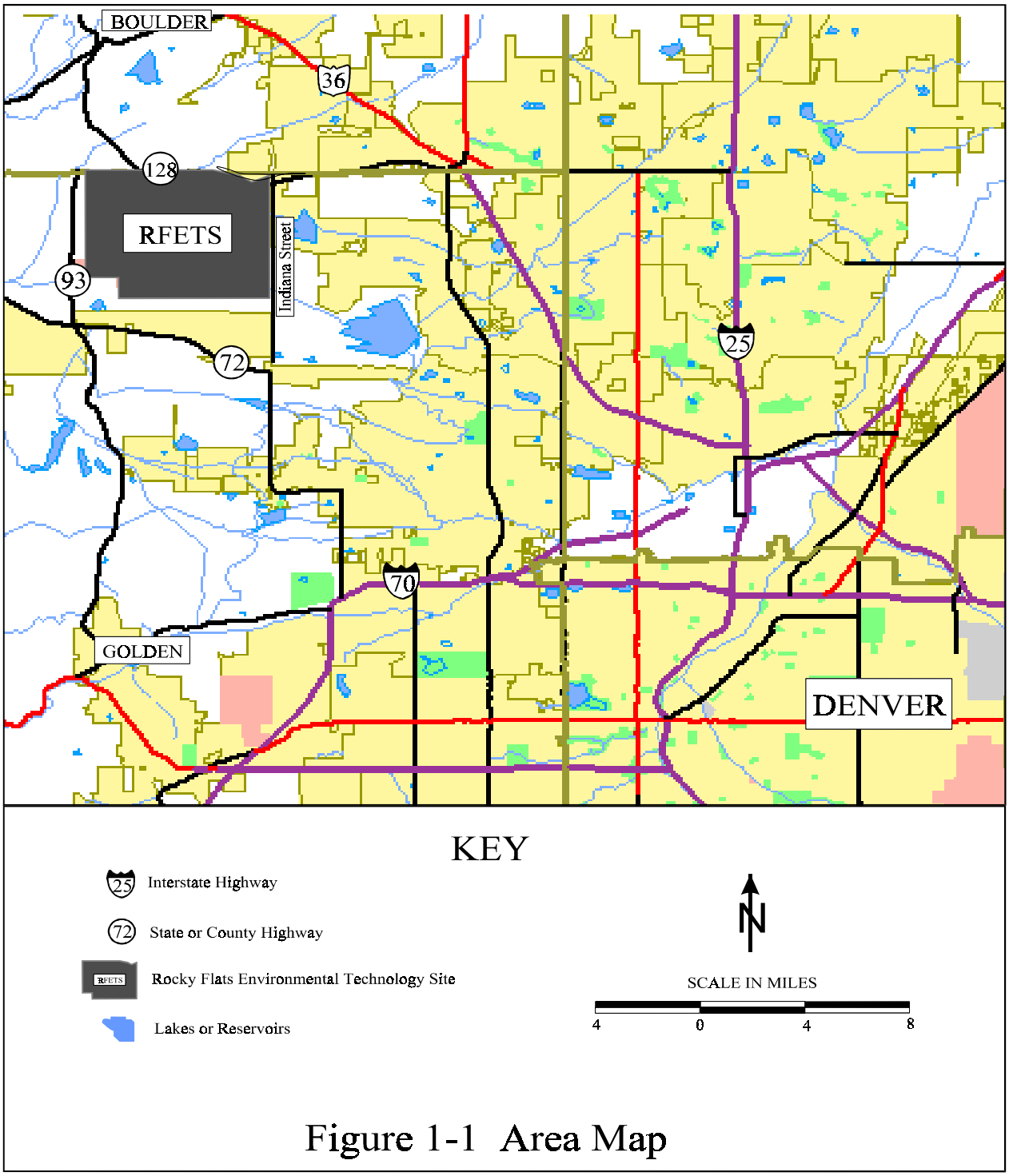

Figure 1-1 Area Map

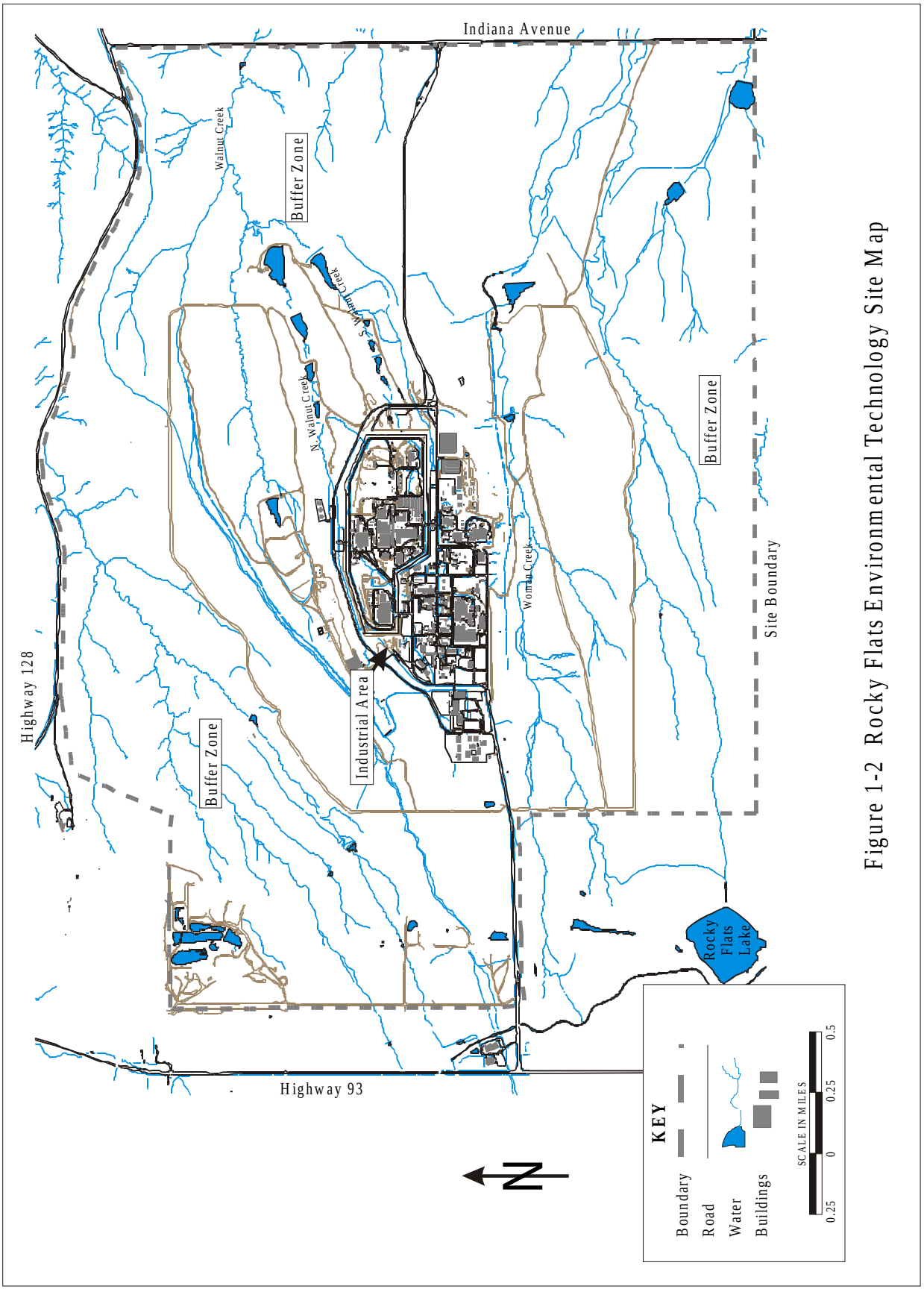

Figure 1-2 Rocky Flats Environmental Technology Site Map

2.0 PROPOSED ACTION AND ALTERNATIVES

Because the Site's LLMW currently exists in a variety of chemical and physical forms and packaging configurations, there are a variety of on-site treatment processes that could be used to treat the wastes. In general, the treatment processes fall into two categories:

1) processes that can be implemented through the use of mobile equipment, allowing treatment to occur at locations where the LLMW is stored; and
2) processes that require a fixed treatment location, wherein the LLMW must be transported to the treatment facility.

The second alternative was considered but dismissed from further consideration for reasons identified in Section 2.3. The No action alternative, which would require the continued on-site storage of LLMW, without treatment, is discussed in Section 2.2.

2.1 Proposed Action

The proposed action would be to treat certain LLMW on-site, prior to shipment off-site for disposal, using one of ten known treatment processes for LLMW. About 2,500 to 5,200 m^3 of LLMW may require on-site treatment. This estimate may change as LLMW streams are better characterized, and as additional off-site treatment capabilities become available. The wastes are stored throughout the industrial portion of the Site (see Figure 1-2) in wooden crates, 55-gallon drums, 10-gallon drums, 1- and 2-liter stainless steel cans, 1- to 4-liter plastic bottles, 1- to 2-liter tin-coated steel cans, plastic bags, vials, and other containers.

Depending upon the waste type, treatment may include one or more of the following processes:

- stabilization/immobilization-polymer macroencapsulation,
- stabilization/immobilization-polymer microencapsulation,
- stabilization/immobilization-cementation,
- neutralization,
- destruction-alkaline chlorination of cyanides,
- destruction-ultraviolet (UV) oxidation,
- separation/decontamination–supercritical CO_2 extraction,
- separation/decontamination–low temperature thermal desorption,
- separation/decontamination–catalyzed chemical oxidation, and
- surface decontamination.

Treatment by these processes would accomplish one or more of the following goals:

- convert wastes to less reactive forms,
- immobilize respirable fines (very small radioactive particles which could be inhaled),

- remove surface contaminants, or
- remove liquids from the waste.

These treatment processes are established processes, which have been used or approved for use at the Site or successfully used in similar applications for similar wastes.

The ten proposed processes are described in Table 2-1, and a general process flow diagram for each treatment is provided in Appendix A. Table 2-1 also provides typical process rates, anticipated annual maximum treatment volumes, and quantities of secondary wastes that could be generated.

DOE estimates that 105 m^3 of secondary waste would be generated per year. Secondary wastes include excess hardened resins, spent reagents, sludges, PPE, plastic sheeting and tubing, granulated activated charcoal (GAC) filters, organic liquids, and similar wastes generated during the treatment processes. The secondary wastes would include solid waste, hazardous waste, low level waste (wastes having less than 100 nanocuries of alpha activity from transuranic elements per gram), and LLMW. Most of the secondary waste would be classified as LLMW.

To facilitate efficient treatment, most of the proposed treatment processes would be deployed on mobile, skid-mounted units. The treatment equipment could therefore be moved from location to location. Some wastes may also be moved from one on-site location to another on-site location for treatment. Wastes would be unpacked, treated, and packaged as necessary (typically a 55-gallon drum would be used). After packaging, the containers would be sent to an approved storage area. Transfers would be made by truck using the most direct route that would be free of construction or other hazards. The proposed processes would involve the following steps:

- Wastes would be staged and moved from their current locations to the skid-mounted treatment units. The wastes would generally be retained in their original containers during transport. If the containers are damaged, the wastes may be repacked or overpacked before being moved.
- Containers would be inspected prior to treatment, as necessary, using real time X-ray radiography to examine the contents. Wastes would be sampled as necessary to determine waste characteristics.
- The containers would be opened and the treatment for that particular waste would be performed.
- Treatment processes would ensure that contaminants would not become airborne during treatment and would not escape to the atmosphere. Exhaust gases from most processes would flow through a controlled ventilation system and a GAC canister that remove hazardous constituents, prior to release through the building's HEPA (high efficiency particulate air) filtered exhaust system. Some waste processes (e.g., for beryllium) would not require GAC filtration. When treating liquid wastes, secondary containment would be provided to prevent spilled wastes from leaving the treatment area. Workers needing to enter the contamination control cell would wear appropriate PPE, such as respirators and protective clothing.

- If required, the wastes would be repackaged after completion of the process.
- Sanitary wastes generated would be disposed of through the Site's contract for solid waste disposal.
- The containers would be shipped off-site to an approved location or stored on-site in approved areas and containers until shipment.

Treatment activities and waste movements would be performed by qualified operators in accordance with approved Site procedures. Planned construction activities associated with the proposed action would occur within existing buildings at the Site and would not require substantial additions to Site buildings or utilities. New air monitors, HEPA air filters, water lines, and electrical connections may be needed at some of the facilities that would be used to house a process.

For purposes of analysis, this EA establishes a maximum amount of waste to be treated per year by a specific process (see Table 2-1). One or more of the processes would be used to treat a specific LLMW stream.

2.2 No Action Alternative

The No action alternative would involve not treating the LLMW streams addressed in this EA. Because off-site shipment of these wastes is also not feasible, the No action alternative would require long-term or permanent storage of some LLMW at the Site.

Existing facilities could be used as long as each facility remained in suitable condition. Some consolidation of wastes at a single facility would be expected, especially for those wastes stored in small quantities.

Ongoing programs to clean up the Site would continue under the No action alternative, but some programs might be delayed or otherwise modified. The continued generation of LLMW and storage of LLMW could interfere with activities to clean up various facilities at the Site. Closing one facility would mean moving wastes to another location, thereby limiting the eventual removal of buildings. The Site would also need to continue and expand waste management activities; such as inspections and replacement of containers showing signs of severe rusting, apparent structural defects, or leakage.

Implementation of the No action alternative would raise safety concerns and place the Site in non-conformance with the Settlement Agreement and Compliance Order on Consent No. 93-04-23-01 issued by the CDPHE. Selection of the No action alternative would also limit future uses of portions of the Site, and impede progress toward achieving the Site's mission of cleanup and closure.

Table 2-1
Treatment Processes

Type of Process	Process Description	Process Rates	Max. Waste Treated/Yr	Secondary Waste[5]
Stabilization/ Immobilization – Polymer Macroencapsulation[1]	Debris waste (dry material only) is placed in a wire basket suspended inside a drum liner. A two-part resin system (an epoxy resin and hardening agent) is mixed, and the resulting mixture poured into the drum. The resin hardens and forms a continuous barrier around the waste. The resin hardening is an exothermic reaction that can reach 170^{o}C. Immobilization would be used for waste forms that have metals as a principal contaminant, and that do not contain large quantities of organic compounds.	Maximum: 8 55-g drums/day (1600 lbs) or 1.6 m^3/day Expected: 4 55-g drums/day (800 lbs) or 0.8 m^3/day	480 drums/yr (96,000 lbs) or 96 m^3/yr	60 drums/yr or 12 m^3/yr
Stabilization/ Immobilization – Polymer Microencapsulation[1]	Small particle waste is mixed with a two-part resin system (epoxy resin and hardening agent), and the resulting mixture poured into a drum. The resin hardens and forms a continuous barrier around the waste. The resin hardening is an exothermic reaction that can reach 170oC. Immobilization would be used for waste forms that have metals as a principal contaminant, and that do not contain large quantities of organic compounds.	Maximum: 4 55-g drums/day (800 lbs) or 0.8 m^3/day Expected: 2 55-g drums/day (400 lbs) or 0.4 m^3/day	240 drums/yr (48,000 lbs) or 48 m^3/yr	60 drums/yr or 12 m^3/yr
Stabilization/ Immobilization – Cement[1]	Waste is mixed with Portland cement in a mixer. The mixture is poured into a high-density polypropylene drum liner, inside a 55-g drum, and allowed to solidify. Immobilization would be used for waste forms that have metals as a principal contaminant, and that do not contain large quantities of organic compounds.	Maximum: 4 55-g drums/day (800 lbs) or 0.8 m^3/day Expected: 2 55-g drums/day (400 lbs) or 0.4 m^3/day	240 drums/yr (48,000 lbs) or 48 m^3/yr	60 drums/yr or 12 m^3/yr
Neutralization[2]	Corrosive liquid wastes are neutralized by adding neutralizing chemicals. The process takes place in a tank, which also provides radioactive containment. Instrumentation monitors the change in pH.	Maximum: 2 55-g drums/day (400 lbs) or 0.4 m^3/day Expected: 1 55-g drum/day (200 lbs) or 0.2 m^3/day	240 drums/yr (48,000 lbs) or 48 m^3/yr	60 drums/yr or 12 m^3/yr – PPE, plastic, etc. 20 drums/yr or 4 m^3/yr - sludges

Destruction– Alkaline Chlorination of Cyanides [2]	Cyanide destruction consists of a mixing tank, and an electrochemical cell that converts chloride ions to free chlorine. The free chlorine reacts with the cyanide to break the C-N bonds. Results of the cyanide destruction process are a liquid waste and a precipitate. Following organic removal, if needed, precipitates are solidified and immobilized. The liquid would be sent to Building 374 for treatment.	Maximum: 10 g/day Average: 5 g/day	None in the inventory at this time	3 drums or 0.6 m^3/yr - misc. waste 4 drums or 0.8 m^3/yr – metal-bearing sludges
Destruction– Ultraviolet (UV) Oxidation[2]	An UV light source and hydrogen peroxide are used to break down organic compounds, usually in aqueous solutions. The system consists of an UV light source, a reagent pump to add hydrogen peroxide, and a liquid waste storage vessel.	Maximum: 1 liter/day Expected: 0.5 liter/day	120 liters/yr	3 drums or 0.6 m^3/yr - misc. waste 120 liters – aqueous waste
Separation/ Decontamination – Supercritical CO_2 Extraction[1,3]	CO_2 is heated at 30°C to 50°C and pressurized from 900 to 1500 psi. The organic compound dissolving qualities of CO_2 in this state allow the fluid to pass easily through waste materials, dissolving and extracting organic compounds. The fluid is used as a solvent to remove organic contaminants from the surfaces of debris material. Most of the CO_2 is captured and recycled; some CO_2 is vented. Contaminants are collected as a liquid waste. Typically, the waste would be immobilized following the organic removal.	Maximum: 4 55-g drums/day (800 lbs) or 0.8 m^3/day Expected: 2 55-g drums/day (400 lbs) or 0.4 m^3/day	240 drums/yr (48,000 lbs) or 48 m^3/yr	60 drums/yr or 12 m^3/yr 1 drum/yr or 0.2 m^3/yr – organic liquids 2 drums/yr or 0.4 m^3/yr - GAC
Separation/ Decontamination – Low Temperature Thermal Desorption[1,3]	Low-temperature thermal desorption includes pretreatment (sorting and size reduction) as necessary, followed by drying and heating. Debris wastes are heated in a vacuum (to approximately 120°C), causing volatile organic contaminants to evaporate from the surface of the waste. Steam would be added to the low temperature thermal desorption unit to stabilize plutonium fines. A condenser, a high-efficiency particulate air filter, and GAC filter treat off-gasses from this process before release to the atmosphere. Typically, the waste would be immobilized following the organic removal process.	Maximum: 4 55-g drums/day (800 lbs) or 0.8 m^3/day Expected: 2 55-g drums/day (400 lbs) or 0.4 m^3/day	240 drums/yr (48,000 lbs) or 48 m^3/yr	60 drums/yr or 12 m^3/yr 1 drum/yr or 0.2 m^3/yr – organic liquids

Separation/ Decontamination – Catalyzed Chemical Oxidation[1]	Chemical oxidation, in the presence of a catalyst, is used to oxidize organic compounds to carbon dioxide and water. The process chemically degrades wastes by exposing them to a hydrochloric acid solution, iron, and other catalysts. Oxygen is injected into the solution. A slightly elevated temperature (200°C) and moderate pressure (100 pounds per square inch gauge) is used in the process. The spent solution is neutralized with diluted caustic solutions, and immobilized.	Maximum: 1 55-g drum/day (200 lbs) or 0.2 m^3/day Expected: 0.5 55-g drum/day (100 lbs) or 0.1 m^3/day	240 drums/yr (48,000 lbs) or 48 m^3/yr	60 drums/yr or 12 m^3/yr 10 drums/yr - spent process reagents or 2 m^3/yr
Surface Decontamination[4]	Visible surface contamination is removed using high pressure water sprays, grit blasting, or CO_2 pellet blasting. The spent decontamination medium (water, grit or carbon dioxide) and the removed contamination (e.g., rust) would be handled as LLMW.	Maximum: 8 55-g drums/day (1600 lbs) or 1.6 m^3/day Expected: 4 55-g drums/day (800 lbs) or 0.8 m^3/day	480 drums/yr (96,000 lbs) or 96 m^3/yr	60 drums/yr or 12 m^3/yr – misc. waste 5 drums/yr blasting grit or 1 m^3/yr 5,000 g/yr water - high pressure sprays

Notes:
Systems would not be restricted to a specific location other than inside the Site boundaries.
One shift per day is anticipated, and used for this table.
Radioactive materials would be less than 100 nanocuries/g.
Worker exposure estimates are 750 mrem/yr maximum; 100 mrem/yr expected
Secondary wastes are a byproduct of the treatment, including items such as polyethylene plastic sheeting, Kimwipes, Tyvek, elastomer PPE, excess resins, process reagents, water, sludges, and GAC filters. Secondary wastewater would be disposed of at Bldg. 374, a permitted facility.

[1]The process would occur inside an appropriate radioactive control enclosure, which would require a controlled airflow.
[2]The process would occur inside an appropriate radioactive control enclosure, which would require a controlled airflow and complete spill containment.
[3]Organic liquids or GAC would be disposed of through an approved off-site vendor.
[4]The process would occur inside an appropriate radioactive control enclosure, which would require a controlled airflow and continuous radionuclide air monitoring.
[5]Secondary wastes, as appropriate, may be further treated by one of the on-site processes or shipped off-site for treatment or disposal.

Source: RMRS, 1998

2.3 Alternatives Not Considered In Detail

Another alternative that was considered was to treat LLMW on-site, using processes that require a stationary location. Two alternative treatment processes in this category, fluidized bed incineration (FBI) and microwave solidification, were considered. While FBI and microwave solidification processes have been tested and used at other locations, these processes have been dismissed from further consideration for use at the Site, as discussed in the following paragraphs.

Both the FBI and microwave solidification treatment processes would likely require a permanent location on the Site, resulting in additional handling and transport of the waste.

The use of the FBI would require obtaining an air quality permit from the CDPHE prior to construction and operation (DOE, 1994); the microwave solidification treatment process may require an air quality permit. The type of permit (e.g., minor source air quality construction permit; non-attainment area air quality construction permit) would depend on factors such as regional air quality, the potential to affect Prevention of Significant Deterioration (PSD) areas, and the potential to emit various air pollutants. A permit application would be subject to a public review, a process that would likely take six months to two years, assuming that no problems are encountered with permit data and submittals. These technologies have often generated extensive public opposition, which would further delay the process. Purchasing, constructing, and testing the selected process would take additional time.

The timely use of FBI and microwave solidification is considered impractical for the Site. The use of these processes would likely delay treatment of LLMW, thereby affecting the Site's ability to meet the accelerated off-site shipment schedule required by Rocky Flats Cleanup Agreement (RFCA). In addition, implementation of these processes would likely result in greater environmental impacts. For these reasons, this alternative has been eliminated from further consideration.

3.0 Affected Environment

The Site is located on 6,266 acres in rural northern Jefferson County, Colorado, 16 miles northwest of downtown Denver. As shown in Figure 1-2, an industrial area occupies about 384 acres in the middle of the Site. The remaining property forms a Buffer Zone around the active part of the Site. The Buffer Zone provides a distance of more than one mile between the industrial area and any public road or private property. Most of the land surrounding the Site is rural open space, but residential areas within five to ten miles are growing rapidly. Nearby communities include Leyden, Boulder, Broomfield, Westminster, Arvada, Superior, and Golden.

The proposed action or alternative actions would be limited to the industrial portion of the Site, and would most likely affect the following resource areas:

- air quality;
- human health and safety;
- water quality and quantity;
- waste management; and
- cultural resources.

The proposed action and alternative actions have little potential to affect other environmental resources, as discussed in the following section.

3.1 Environmental Resources Not Affected

Potential impacts to floodplains, ecological resources, geology and soils, socioeconomic resources, and aesthetics have not been analyzed in detail in this EA. In general, these resources would not be affected due to the nature of the proposed activities or the absence of these resources from the affected area, as discussed below.

The Site is not located within a 100-year floodplain as classified by the U.S. Army Corps of Engineers (COE, 1992), therefore, floodplain impacts would not occur. Similarly, wetlands are not considered further, because no wetlands are found in the project vicinity. The industrial area, where the proposed activities would occur, is intensely developed, and contains limited plant and animal habitat. No threatened and endangered species have been identified in the industrial area.

Geology and soils also would not likely be affected. No excavation work or other soil disturbance would be required to accommodate the proposed treatment equipment; equipment would be skid-mounted and mobile. Equipment would be moved from building to building, with only small amounts of waste moved to the treatment location. Proposed treatment processes would be located inside existing facilities with adequate spill containment.

The proposed activities would require only a small work crew, already employed at the Site, and socioeconomic impacts would be minimal. The proposed activities would occur within

the industrial area of the Site, away from off-site populations, including minority or low income populations. Since the proposed activities would be similar to other ongoing activities in the industrial area, changes to visual resources and noise would be minimal.

3.2 Air Quality

The Site is located in the southern Rocky Mountain region, and has a continental, semi-arid climate. The region is noted for large seasonal temperature variations, occasional dramatic short-term temperature changes, and strong, gusty winds, which reach 75 miles per hour (mph) annually and 100 mph every three to four years. Mean annual precipitation is about 15.5 inches, with about one half of that amount occurring as snow.

Although air quality is generally better at Rocky Flats than in the urbanized portion of the Denver Metropolitan Area, the Site is continuously and extensively monitored for air pollutants. Air emissions from Rocky Flats are within limits for all pollutants for which there are standards (DOE, 1997a). The U.S. Environmental Protection Agency (EPA) regulates six "criteria" pollutants:

- ozone,
- carbon monoxide,
- nitrogen oxides,
- sulfur dioxide,
- fugitive dust or particulate matter smaller than ten microns in diameter (PM_{10}), and
- lead.

The Site is located within the Metropolitan Denver Intrastate Air Quality Control Region No. 36 (Region). The Region is designated as "nonattainment" with respect to the National Ambient Air Quality Standards for PM_{10} and carbon monoxide (EPA, 1998). The particulate matter standard is exceeded within the Region primarily because of fugitive dust. Vehicular traffic is a major contributor to the high concentration of carbon monoxide in the region (DOE, 1997a).

Radiological air emissions both on- and off-site are largely unrelated to Site operations. Most radiation is naturally occurring background radiation from sources such as radon. The annual background dose for Denver area residents is about 418 mrem (more than 1 mrem per day). Radioactive emissions from the Site are principally from contaminated soil, with an annual dose for the nearest most impacted off-site resident of about 0.1 mrem (DOE, 1997b). Facilities with potential radionuclide emissions are continuously monitored at emission points to ensure that emissions are properly controlled and comply with regulations.

Hazardous air pollutants (HAPs) include a wide range of materials or chemicals that are toxic or potentially harmful to human health. HAPs are found in numerous products and used in many processes. An example is methylene chloride, which was widely used as a solvent. Most HAPs are released in very small quantities and typically pose the greatest threat to workers. HAPs are regulated by total cumulative releases from all processes.

Additional details on meteorology, air quality, monitoring, and air emission controls at the Site can be found in the *Rocky Flats Cumulative Impacts Document* (CID) (DOE, 1997b).

3.3 Human Heath and Safety

Potential human health and safety concerns relate to both workers and the public under routine and accident scenarios.

Workers are exposed routinely to ionizing radiation during normal operations at Rocky Flats. DOE's approach to radiation protection is one that keeps exposures to workers and the public to levels "as low as reasonably achievable" (ALARA). Accordingly, worker doses are maintained below regulatory and contractual limits.

A combination of administrative controls, engineered controls and PPE is used at the Site to limit radiation exposure to the worker. DOE worker dose restrictions are outlined in federal regulations at 10 CFR Part 835. The annual limit for whole body exposure is 5 rem; however, DOE has set a lower annual limit of 2 rem, which is called the administrative control limit. As part of its site-specific ALARA program, the Site has set an even lower annual limit of 750 mrem, which is applicable to most activities and workers at the Site.

Workers also handle and use various hazardous chemicals during operations, and remove hazardous wastes. A material or waste is considered hazardous because of characteristics, such as ignitability or corrosiveness; or because they contain regulated constituents, such as toluene or cyanide. Personnel working with hazardous chemicals or wastes are required to have training describing hazards, and must follow procedures addressing potential safety problems, as outlined in the Site's Health and Safety Plan (HASP). All hazardous wastes must be handled in accordance with RCRA, which mandates specific protections for human health and safety.

For the purposes of analysis, the public is defined as those individuals who live within a 50-mile radius of the Site. A conservative approach is used to assess risk to the public, which assumes that the maximally exposed individual (MEI) is a person who lives continuously at a point on the Site boundary, where exposure to contaminants would be the highest.

Releases of hazardous chemicals or wastes are regulated through various environmental protocols. For example, air quality regulations specify allowable air emissions and air monitoring requirements; water quality regulations specify monitoring and release requirements for water from the Site. Federal regulations limit off-site exposures to radionuclides, stating that: "emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/year" (40 CFR 61, Subpart H, Section 61.93).

The existing radiological conditions at the Site have been reported in the CID (DOE, 1997b). The total dose to Site workers in 1996 was estimated to be 263 person-rem, with a corresponding estimate of much less than one resulting latent cancer fatality. The annual dose

to an off-site MEI from existing operations, in the years 1990-1994, ranged from 0.1 to 0.52 mrem.

3.4 Water Resources

Surface Water

The Site is situated within the headwaters of two regional drainage basins: Boulder Creek basin and Big Dry Creek basin. Three stream systems, Walnut Creek, Woman Creek, and Rock Creek, are located within these basins. The stream systems are ephemeral and intermittent, and drain the Site in a west-to-east pattern. The proposed action would be located in the Site's industrial area, which lies between Walnut Creek and Woman Creek, as shown in Figure 1-2.

Water from the industrial area is collected and routed to Walnut Creek and Woman Creek. Water in the creeks is collected in a series of detention ponds, which were constructed as part of the Site's runoff control and pollution prevention programs.

Surface water in the detention ponds, and at the border of the Site, is sampled prior to being discharged. Discharges are monitored under the National Pollutant Discharge Elimination System (NPDES) Permit Program and the RFCA.

Additional information on the surface water at the Site can be found in the CID (DOE, 1997b).

Groundwater

Major groundwater units at the Site include, from deep to shallow, the Laramie-Fox Aquifer, a shale aquitard (the upper unit of the Laramie Formation), the Arapaho Formation Aquifer, and the surficial Rocky Flats Alluvium. The upper unit (Rocky Flats Alluvium) is an unconfined aquifer, and the lower units are confined aquifers.

An unconfined aquifer receives water infiltrating from the surface, and is, therefore, at the greatest risk of being contaminated. Aquifer recharge occurs through direct infiltration or percolation; infiltration from surface water when the water table lies below a stream or canal; inter-aquifer leakage (or flow from one aquifer to another); and infiltration from artificial sources, such as detention ponds, surface water impoundments, sewer lines, and dry wells.

A confined aquifer is isolated from other aquifers and the surface by an aquitard (nonporous layer). Confined aquifers can be contaminated if wells or inter-aquifer leakage allows contaminants from one aquifer to mix with waters in the confined aquifer.

Groundwater monitoring at the Site has been conducted since 1960, and has identified both radiological and nonradiological contaminants in the groundwater. Studies show that groundwater contamination is highly unlikely to leave Rocky Flats and migrate into confined

aquifer systems offsite (DOE, 1995; 1996). Additional information on groundwater can be found in the CID (DOE, 1997b).

3.5 Waste Management

Secondary wastes generated in the treatment of LLMW could include solid waste, hazardous waste, low level waste, and LLMW. Waste management at the Site includes spill response preparation.

Most Site activities generate solid waste, which, for the purpose of this EA, is a waste that does not have regulated levels of hazardous constituents or radionuclides. Trash, garbage, and yard waste are typical types of sanitary waste. Sanitary waste disposal is regulated by the State. The sanitary waste program provides for the collection, handling, and disposal of wastes, most of which are sent to off-site landfills. Other non-hazardous waste includes wastewater, which is treated at the Site's wastewater treatment plant. Site waste metrics show that volumes of non-hazardous waste on-site have been decreasing (RMRS, 1998).

A hazardous waste is any liquid, solid, semisolid, or contained gas that is specifically listed as a hazardous waste, or that exhibits a characteristic of hazardous waste (ignitability, corrosivity, reactivity, or toxicity) as determined by prescribed analytical procedures. Hazardous waste is regulated under State (6 CCR 1007-3) and Federal (40 CFR 261) regulations. Hazardous waste must be carefully managed from the point of generation until the time that a safe and appropriate disposal is achieved; a concept known as "cradle to the grave". Regulations specify requirements for identifying, classifying, generating, transporting, tracking, storing, treating, disposing, or otherwise managing hazardous wastes. About 160 m^3 of containerized non-radioactive hazardous wastes are currently stored on-site (RMRS, 1998).

Low level wastes have less than 100 nanocuries of alpha activity from transuranic elements per gram, but do not have non-radiological hazardous components. Low level wastes can be generated from numerous processes, and include wastes such as expended tubing and GAC filters.

LLMW include hazardous and radiological components. All wastes must be characterized or profiled to determine both the hazardous and radiological components. At the present time, about 17,000 m^3 of LLMW are stored in containers at the Site. Another 65,000 m^3 are expected to be generated by Site activities. While most of this waste can be directly disposed of off-site or treated off-site, the rest must be characterized and treated at the Site. Currently, most of the LLMW is found in the 700 and 900 areas of the industrial portion of the Site.

3.6 Cultural Resources

The Site was one of only 13 nuclear weapons production sites in the United States during the Cold War Era. In 1995, DOE conducted a survey of cultural resources in the Industrial Area and has evaluated the Cold War Era resources using guidelines set forth by the Department of Interior. This survey determined that 64 facilities at the Site are highly important to the

regional, national and international history for their role in the Cold War Era. Additionally, the State Historic Preservation Officer determined that these facilities are eligible for the National Register of Historic Places as an historic district. The Rocky Flats Plant Historic District (site 5JF1227) was placed on the National Register of Historic Places on May 19, 1997. Documentation and preservation requirements are set forth in a Programmatic Agreement signed by the Department of Energy Rocky Flats Field Office; the Colorado State Historic Preservation Officer; and the Advisory Council on Historic Preservation.

4.0 Environmental Impacts

This chapter assesses the potential impacts from on-site treatment of LLMW to the resource areas identified in Chapter 3. This chapter also discusses the potential impacts of the No action alternative, assesses cumulative impacts, and provides conclusions.

4.1 Proposed Action

4.1.1 Air Quality

Air quality analysis demonstrates that the proposed action would have minor adverse impacts on ambient air quality during operation of the treatment processes. Radiological impacts would be well below federal standards for workers and the public. Criteria and hazardous air pollutants would be released in amounts below applicable federal and state standards. No ozone depleting substances would be released. Air quality impacts would cease after treatment of LLMW is completed.

The air quality analysis was based on a review of existing air quality in the region, information on existing Site air emission sources, and projections of criteria pollutants, HAPs, and radiological emissions that would be generated during treatment processes. An increase in criteria pollutant emissions that could affect regional air quality attainment standards, or a long-term exposure to a HAP or any other air pollutant above the permissible exposure limit (PEL), would be considered adverse. An effective dose equivalent (EDE) exposure to radionuclides, to any member of the public, of 10 mrem/year (yr) or more would be a noted adverse impact. The EDE is determined by using the EPA-approved computer dispersion model CAP88PC. A reduction in air pollutant emissions would be beneficial.

Table 4-1 lists the projected uncontrolled non-radionuclide emissions from the LLMW treatment technologies (estimated conservatively since no credit is applied for control technologies). These emissions were estimated based on maximum expected process rates, EPA emission factors, and assumptions listed in Appendix B. The complete air analysis is located in Appendix B.

Combined estimated emissions of uncontrolled non-radionuclide air pollutants from the LLMW treatment technologies will not exceed the most stringent regulatory reporting threshold of 250 lb/yr for individual HAPs, nor the 2,000 lb/yr permitting and reporting threshold for criteria pollutants. Therefore, non-radionuclide emissions would have only a minor adverse impact on the environment.

As shown by the above estimation for non-radionuclide emissions, air emissions of criteria pollutants would be below reporting thresholds, and would not affect conformity with the State Implementation Plan. Emissions would not impact PSD requirements. There would be no long-term adverse impacts to air quality following treatment of the Site's LLMW.

Table 4-1
Estimated Non-radionuclide Air Pollutant Emissions in Pounds/Year (lb/yr)

Technology[1]	TSP (PM-10)	VOC	HAP (VOC)	HAP (Acid)
Neutralization	--------	112	4	94
Stabilization/ Immobilization[2]	87	914	33	--------
Separation/ Decontamination[3]	144	228	8	--------
Surface Decontamination	208	--------	--------	--------
Total Emissions	439	1,254	45	94
Permitting or Reporting Thresholds	2,000 lb/yr	2,000 lb/yr	250 lb/yr[4]	250 lb/yr[4]

[1]Emissions are uncontrolled

[2]Includes polymer macroencapsulation, polymer microencapsulation, and cement processes

[3]Includes supercritical CO_2 extraction, low temperature thermal desorption, and catalyzed chemical oxidation processes

[4]Using the most stringently regulated HAP

Destruction processes (alkaline chlorination of cyanides; UV oxidation) would not produce significant criteria emissions and are not included

Table 4-2 provides radionuclide emissions from the LLMW treatment technologies. The emissions were estimated based on maximum expected process rates, EPA emission factors, and assumptions listed in Appendix B. The estimated radionuclide emissions from the listed technologies were input into the EPA-approved computer dispersion model CAP88PC, which then provided an estimated EDE to the MEI.

As specified by Federal regulations, the impact analysis uses adjustment factors for effluent controls, which reduce potential releases of *uncontrolled* emissions. Based on the Federal regulations, a control factor of 1E-04 can be used for the two stages of HEPA filters used on the treatment enclosure. Analysis of cementation, macroencapsulation, microencapsulation, neutralization, separation/decontamination, alkaline chlorination of cyanides, and UV oxidation treatment systems running concurrently, and exhausting to the same vent, resulted in an estimated EDE of 4.5E-08 millirem per year (mrem/yr) to the MEI based on *controlled* radionuclide emission estimates.

The surface decontamination treatment system was evaluated as a separate system, exhausting to a separate vent. This system had an estimated EDE of 0.014 mrem/yr to the MEI based on *controlled* radionuclide emissions (using two stages of HEPA filters).

Table 4-2
Estimated Radionuclide Emissions in Curies/Year (Ci/yr)

Treatment Technology	Uncontrolled	Controlled (Two HEPA filters)
Stabilization/immobilization-Polymer Macroencapsulation	3.98E-06[1]	3.98E-10[1]
Stabilization/immobilization-Polymer Microencapsulation	1.98E-06[1]	1.98E-10[1]
Stabilization/immobilization-Cementation	1.98E-06[1]	1.98E-10[1]
Neutralization	3.98E-06[1]	3.98E-10[1]
Separation/decontamination	1.98E-06[1]	1.98E-10[1]
Destruction-UV Oxidation	1.45E-08[1]	1.45E-12[1]
Destruction-Alkaline Chlorination of Cyanides	8.20E-08[1]	8.20E-12[1]
Total	**1.4E-05**[1]	**1.4E-09**[1]
Surface Decontamination	4.35[2]	4.35E-04[2]
Total	**4.35**[2]	**4.35E-04**[2]

[1]Based on an emission factor of 1E-03 from 40 CFR 61, Subpart H, Appendix D

[2]Based on an emission factor of 1 from 40 CFR 61, Subpart H, Appendix D

The level of concern for routine radionuclide emissions, for any member of the public, is an EDE of 10 mrem/yr. The estimated EDE to the most impacted public receptor, resulting from controlled radionuclide emissions from all of the LLMW treatment technologies combined, is 0.014 mrem/yr. Therefore, the proposed action would not generate radionuclide emissions at a level of concern. For comparison purposes, these estimates can be compared to the 418 mrem/yr average background exposure to an individual in the Denver area. The cumulative effect of the projected LLMW process emissions with other Site emissions is also below levels of concern, as discussed in Section 4.3.

4.1.2 Human Health and Safety

Potential environmental impacts associated with human health and safety include those resulting from exposure to radioactive materials; these impacts are discussed for routine operations and potential accidents.

Routine Operations - Worker Exposure

In the course of normal operations, Site radiation workers are exposed to radiation in a controlled manner. As discussed in Section 3.3, these radiation exposures are governed by the

Site's radiation protection program which, among other measures, establishes an administrative limit of 750 mrem/yr for workers involved in processing radioactive materials.

To estimate worker exposures from the proposed action, it was assumed that, consistent with the Site administrative limit, each worker's exposure would be no greater than 750 mrem/yr. Application of the ALARA principle and Site experience indicate that actual individual exposures will actually be much less. Doses to the worker population from the proposed action were conservatively estimated by assuming that all treatment technologies would operate concurrently on the schedules listed in Appendix B, and that two workers are required to operate each treatment module. These assumptions imply that a total of 14 workers would be exposed at 750 mrem/yr, resulting in a cumulative annual exposure to this population of 10 person-rem. Using a latent cancer fatality probability of 0.0004 per person-rem produces a predicted 0.004 latent cancers per year as a result of the proposed action.

Routine Operations - Public Exposure

An estimate of the radiological impact on an MEI at the Site boundary was made as a part of the air quality analysis of the proposed action (Appendix B). Results of this evaluation are presented in Section 4.1.1.

Accidents

Because of the nature of the LLMW treated in the processes addressed in this EA, accidents that could originate within the individual treatment modules are expected to have minor impacts, as the impacts would be confined to the immediate vicinity of the modules. Associated releases from localized module accidents would be contained by the ventilation and filtration systems of the buildings in which modules are located. Involved workers could potentially be injured by physical processes associated with accident propagation. Radiological effects of accidents initiated by more severe phenomena (e.g., earthquake, tornado) would be dominated by impacts associated with damage to the existing buildings that would house the modules. Radiological consequences from bounding accidents at each of the potential building locations for LLMW treatment were reported in the CID (DOE, 1997b). The addition of the proposed treatment modules to these buildings would not significantly affect the results of these analyses (CID, Table 5.14-3).

4.1.3 Water Resources

No direct effects on water resources would result from installing and using any of the treatment technologies. The slight chance for a spill during the on-site transport of LLMW would be the primary concern regarding water resources.

To evaluate the potential water quality impacts, documents on the hydrology and hydrogeology of the area, construction methods, and maps showing topography, watersheds, and stormwater drainage were reviewed. The review focused on the industrial area, building construction, spill response, Site topography and runoff. Adverse effects would occur if groundwater or surface water quality were degraded to a point where it would not meet the

standards set for its designated uses, or the groundwater recharge area or yield were to decrease as a result of the proposed action or No action alternative.

Potential impacts to water resources could result from a spill of LLMW, primarily during transport between facilities. Spilled liquid wastes could infiltrate to groundwater or be carried with stormwater runoff to nearby streams. Spills within facilities do not present a concern since impermeable floors and secondary containment exist in most facilities where wastes would likely be treated, because spill equipment would be readily available, and because spill response actions could be rapidly implemented. Given the amount of waste and location of a release during a worst case spill (i.e., complete and sudden failure of a container during loading or unloading), wastes would be unlikely to reach groundwater. Such a spill would be immediately evident and initiate an immediate response. In addition, it would likely occur on a paved surface that would slow infiltration.

Waste transport between a storage location and a facility containing a treatment process would also present a low potential for spilled wastes to affect surface waters. In order for the spill to have a substantial adverse impact on the environment, a spill would need to include significant quantities of waste and occur during an event (e.g., rainstorm) that would accelerate runoff. A failure in timely spill response would also have to occur. Most LLMW is found in limited areas (e.g., 700 and 900 areas) of the industrial compound where treatment processes are likely to be sited. Therefore, limited movement of most wastes would be required. Wastes would be transferred via trucks or forklifts on paved surfaces, where spills could be readily contained and cleaned up. In the event that spilled waste would be carried out of the industrial area and downgradient to surface water drainages (i.e., Walnut Creek or Woman Creek), the drainage systems have a series of ponds designed to contain runoff and contaminants. Therefore, the potential for the proposed action to impact surface water is low.

4.1.4 Waste Management

To assess potential impacts, the EA analysis focused on handling and transport of wastes, generation of secondary wastes from treatment of LLMW, and storage of wastes. Key elements included the type of treatment operation, types and quantities of waste processed and generated, and the potential for spills. Sources of information include state and federal laws and regulations, Site documents, interviews of Site personnel, treatment process plans, and waste metrics.

An impact is noted if the generated quantities of solid waste, hazardous waste, or LLMW would exceed storage and disposal capabilities, or if the handling, transport, and disposal of the wastes would increase the potential for spills, leaks, or worker and public exposure.

The proposed action would treat LLMW on-site, within existing facilities. LLMW would be moved (generally within the same building) to the treatment module, unpacked, treated, and repackaged as necessary (typically, a 55-gallon drum would be used). Treatment would convert wastes to less reactive forms, immobilize respirable fines, remove surface contaminants, or remove liquids from the waste, resulting in a packaged LLMW that could be shipped to an off-site facility. Following treatment, the containers would be maintained in an

approved storage area. Some processes would generate additional or secondary wastes, which would be packaged and handled according to waste type. Secondary wastes would include excess hardened resins, spent reagents, sludges, PPE, plastic sheeting and tubing, GAC filters, organic liquids, and similar wastes. Most of this waste would be LLMW. About 108 m^3/yr of secondary waste would be generated and stored in containers. Wastewater may also be generated as a secondary waste, and would likely be treated at the Site's wastewater treatment plant.

Stabilization/immobilization processes (polymer macroencapsulation, polymer micro-encapsulation, and cementation) would be used to treat the largest quantities of LLMW. These three processes could treat up to 192 m^3/yr, and generate up to 36 m^3 of secondary waste.

Neutralization could treat up to 48 m^3/yr and produce a total of 16 m^3/yr of secondary waste (12 m^3/yr of solid waste and 4 m^3/yr of sludge).

Although no cyanide wastes are identified in inventory at this time, future work may produce this waste stream. Alkaline chlorination of cyanides could treat a maximum of 2.2 m^3/yr and produce 1.4 m^3/yr of secondary waste. About one half of the secondary waste would be sludge, and one half would be miscellaneous solid waste.

Ultraviolet oxidation would treat very small quantities of waste, limited to about 120 liters/yr (less than 0.1 m^3/yr), producing up to 0.6 m^3/yr of additional miscellaneous solid waste and 0.1 m^3/yr of liquid waste.

Separation/decontamination processes include supercritical CO_2 extraction, low temperature thermal desorption, and catalyzed chemical oxidation. These processes could treat up to 144 m^3/yr. These processes could also produce 36.4 m^3/yr of various solid secondary wastes and 2.2 m^3/yr of liquid wastes.

Surface decontamination processes could treat up to 96 m^3/yr, and produce 13 m^3/yr of used blasting media and other secondary wastes. Surface decontamination could also generate up to 18 m^3/yr of wastewater.

Total treated waste volumes would be 480 m^3/yr for treated LLMW. This volume would be appropriately packaged for off-site shipment and stored on-site pending shipment. An additional waste stream of secondary wastes could add another 108 m^3/yr. Compared to the existing 17,000 m^3 of containerized LLMW currently stored on-site, the potential maximum waste produced annually from all treatment processes would not create a substantive waste management burden.

Solid wastes would be handled through an existing contract, and would be taken off-site. The quantities of solid waste (e.g., empty containers, packaging, and similar debris) would be limited, and could be handled within existing solid waste management practices.

Acceptable wastewater (based on analytical results) would be sent to the Site wastewater treatment plant. The small volume of wastewater (less than 5,000 gallons or 100 m^3/yr) potentially managed via the wastewater treatment plant would be insignificant compared to plant capacities and normal operations, and would not affect the operation of the plant.

4.1.5 Cultural Resources

The proposed action could entail some modifications to buildings within the Rocky Flats Plant Historic District. If modifications occur, the Site would take appropriate measures to document the facilities before alteration. Documentation of the buildings' historical significance would be done in accordance with the State Historic Preservation Officer consultation, and would comply with the Programmatic Agreement signed by the Department of Energy Rocky Flats Field Office; the Colorado State Historic Preservation Officer; and the Advisory Council on Historic Preservation. Applicable laws and regulations pertaining to the Site cultural resources are listed in the *Cultural Resource Management Plan* (DOE, 1997c).

4.2 No Action Alternative

If the No action alternative were selected, no impacts to air quality, water resources, or cultural resources would occur from on-site LLMW treatment. Human health and safety, and waste management, would be adversely affected, as discussed in the following paragraphs.

Human Health and Safety

Under the No action alternative, exposures associated with the treatment processes would not occur. However, since these LLMW could not be shipped off-site, exposures associated with continued on-site storage and management of these wastes would continue indefinitely. A cumulative Site worker radiation dose of 243 person-rem per year is reported in the CID (Section 4.8.1) for Site operations similar to those which would continue if the LLMW are not treated and removed from the Site.

The CID (Table 5.8-4) reports an annual MEI dose of 0.0052 mrem/year for the Baseline Case, which corresponds to a scenario in which the proposed LLMW treatment activities are not accomplished. Unlike the proposed action scenario, these annual doses would continue until other means to treat these LLMW could be identified. The proposed treatment activities would support Site closure, thereby permanently eliminating radiological exposures from Site activities.

There would be no additional risks from accidents that could originate within the individual treatment modules under the No action alternative. Accordingly, the risk of accidents and consequences would continue as stated in the CID Baseline Case (DOE, 1997b).

Waste Management

Continued LLMW storage in multiple locations at Rocky Flats could impede the demolition of Site buildings and, therefore, closure of the Site. As each building is scheduled for

demolition, the waste stored in that building would need to be removed. The waste would then be transferred to another storage location. This would create a repetitive cycle that would increase handling and movement of wastes, and exacerbate LLMW storage problems.

Long-term facility and container maintenance and integrity are serious concerns with the No action alternative. Most of the buildings at the Site were built in the 1950s and 1960s to industrial design standards, and are not suitable for long-term storage. Many of the safety systems in the older buildings require frequent maintenance, indicating deterioration. The probability of an accidental release of LLMW increases over time. The risk of a spill would also increase in direct proportion to the number of times a waste container is handled.

Environmental requirements would continue until eventual disposition of the LLMW. These requirements would include various inspections, maintenance of containers and facilities, training of personnel, and recordkeeping requirements.

Finally, any eventual offsite transfer of LLMW to a long-term storage facility would be impeded. Under the No action alternative, wastes would not be repackaged in appropriate transportation containers and would continue to be stored in multiple locations.

4.3 Cumulative Impacts

Cumulative impacts are those changes to the physical and biological environments which would result from the proposed action, or No action alternative, in combination with other ongoing actions and reasonably foreseeable future actions. There would be no notable cumulative impacts from the proposed action or the No action alternative.

Activities related to Site maintenance and eventual closure would continue on-site. These actions would include, for example, the demolition of facilities, various construction or demolition activities, transportation of materials and wastes, and ongoing remediation activities. No new public or private actions are known or predicted to occur in the near vicinity of the Site.

The short-term increases in air emissions would, in combination with other Site activities, be below reporting or monitoring levels. Criteria pollutants generated by the proposed action would be minor and temporary. Radiological impacts to air quality would also be minor and temporary. The total EDE to the most impacted public receptor from the entire Site during 1997 (Appendix B) was 0.128 mrem (as measured at the Site perimeter). Thus, the estimated 0.014 mrem/yr EDE from the LLMW treatment technologies (as discussed in Section 4.1.1), combined with the 0.128 mrem, would yield a total of 0.142 mrem/yr. An estimated annual dose of 0.23 mrem/yr is presented in the CID (Table 5.8-4) for overall Closure Case Activities. Combining this dose with the 0.014 mrem/yr from the proposed action yields a total dose estimated of 0.24 mrem/yr. Both estimates indicate that radiological doses from the proposed action, even when combined with doses from other activities at the Site, would not be of concern.

Impacts to other resource areas are predicted to be minimal. Considered cumulatively with other ongoing activities at and in the vicinity of the Site, the impacts would not be of concern.

4.4 Conclusions

The analyses of the potential affects of the proposed action on human health and safety and the environment indicate that some adverse impacts could occur, but that they would also be minor and temporary. The proposed action would generate criteria and other air pollutants below levels of concern. Radiological impacts would be well below federal standards for workers and the public. There would be no direct affects on water resources from installing and using any of the treatment processes. The chance for a spill during the on-site transport of LLMW would be slight. Potential impacts to cultural resources could be mitigated through established processes. The No action alternative would not change the existing situation and potential impacts in these areas.

Waste management would benefit from implementation of the proposed action. Preparing LLMW for off-site disposition would assist waste management and provide for better control of wastes, and support the Site's closure goals. Under the No action alternative, continued storage of LLMW in multiple locations at the Site could impede the demolition of Site buildings and closure of the Site. The additional LLMW handling and storage needs, which would occur as buildings are demolished, would adversely affect waste management.

5.0 AGENCIES AND PERSONS CONTACTED

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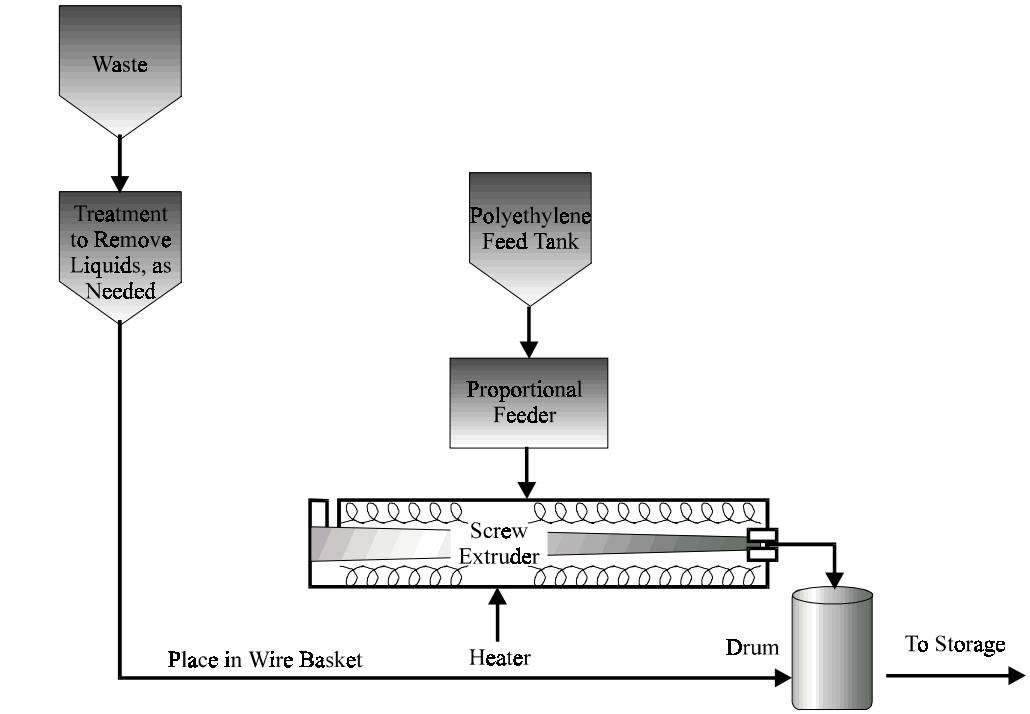
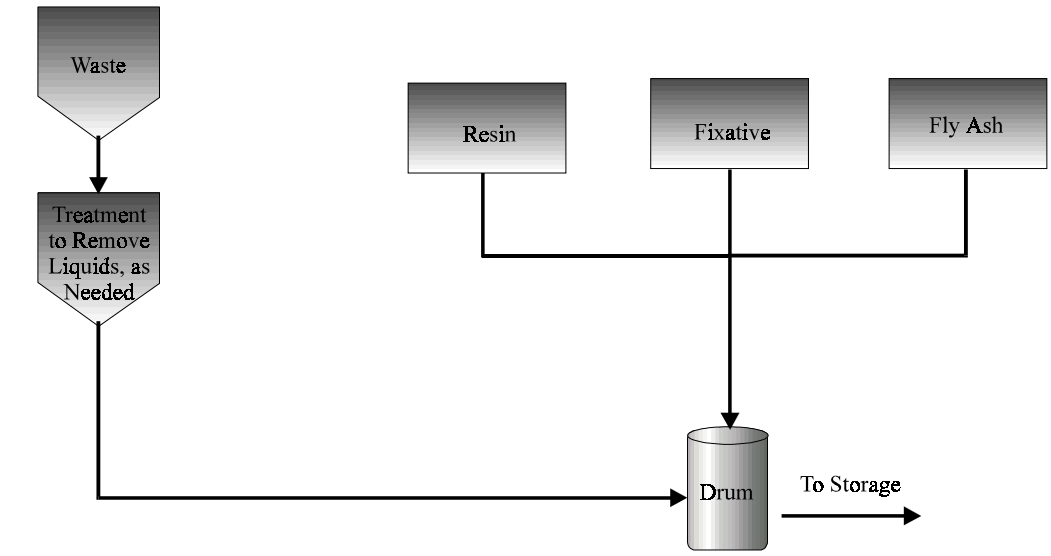
APPENDIX A

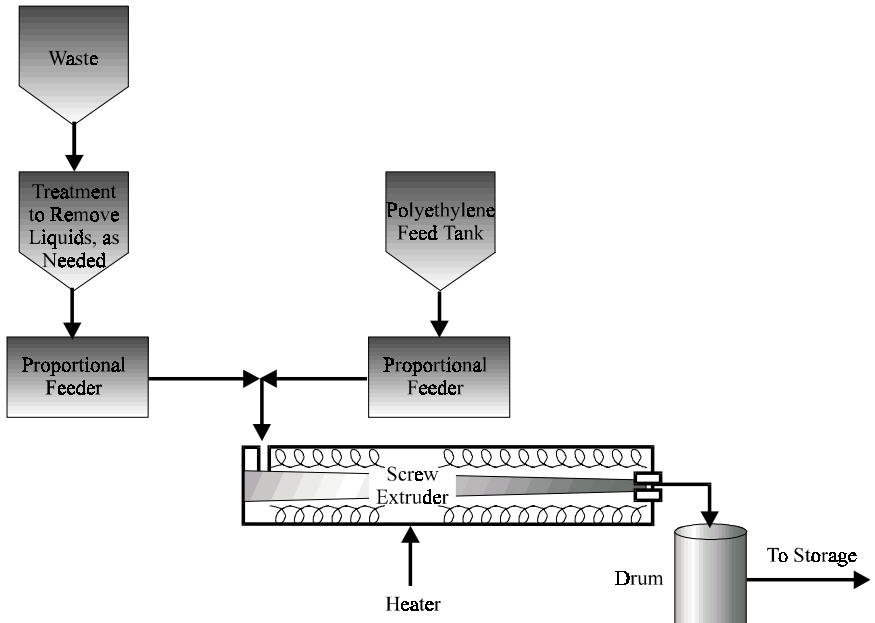


Thermoplastic Variation



Thermoplastic Resin Variation

STABILIZATION/IMMOBILIZATION – POLYMER MACROENCAPSULATION



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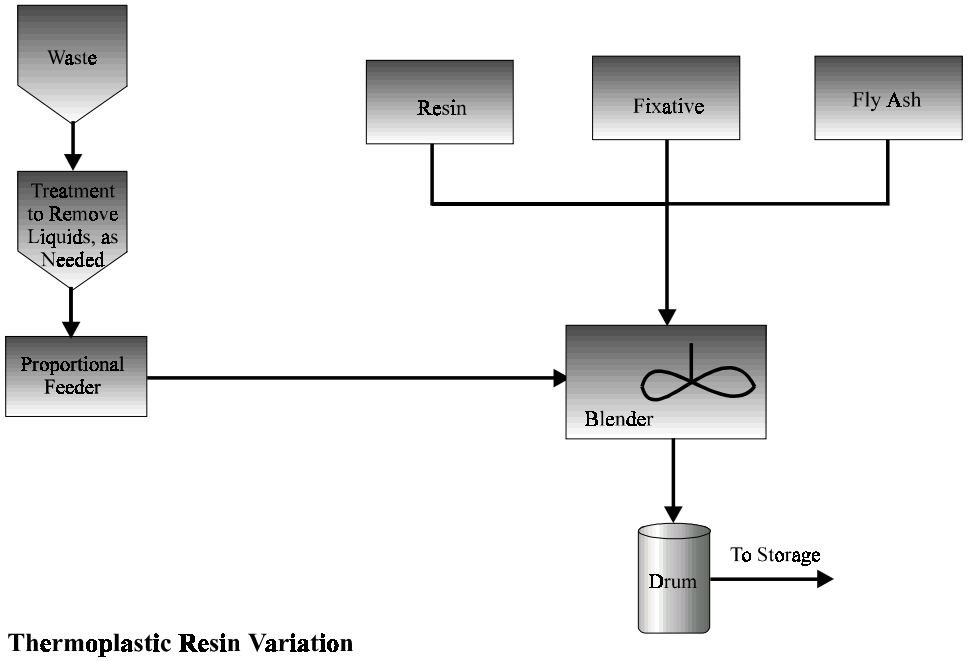
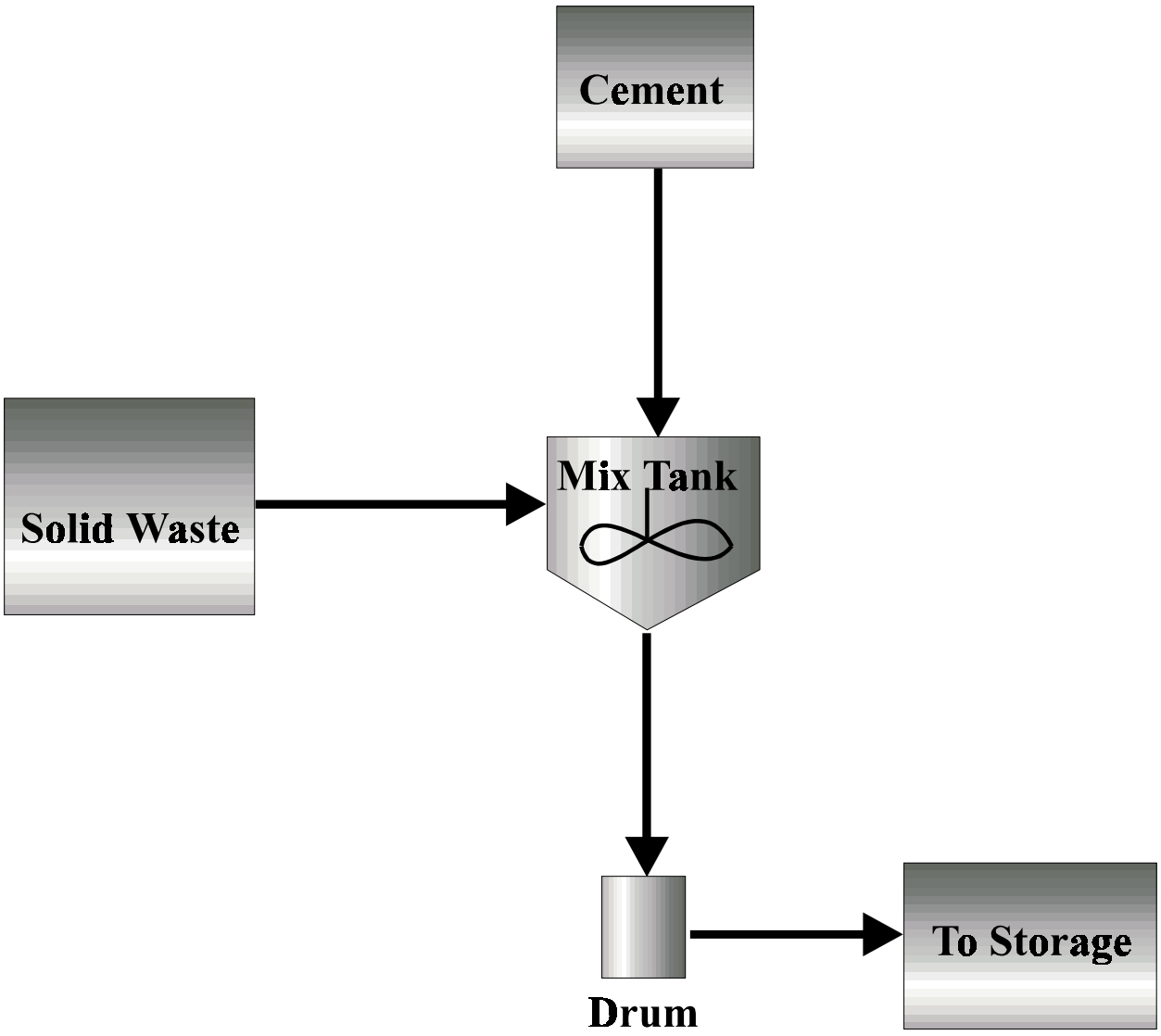
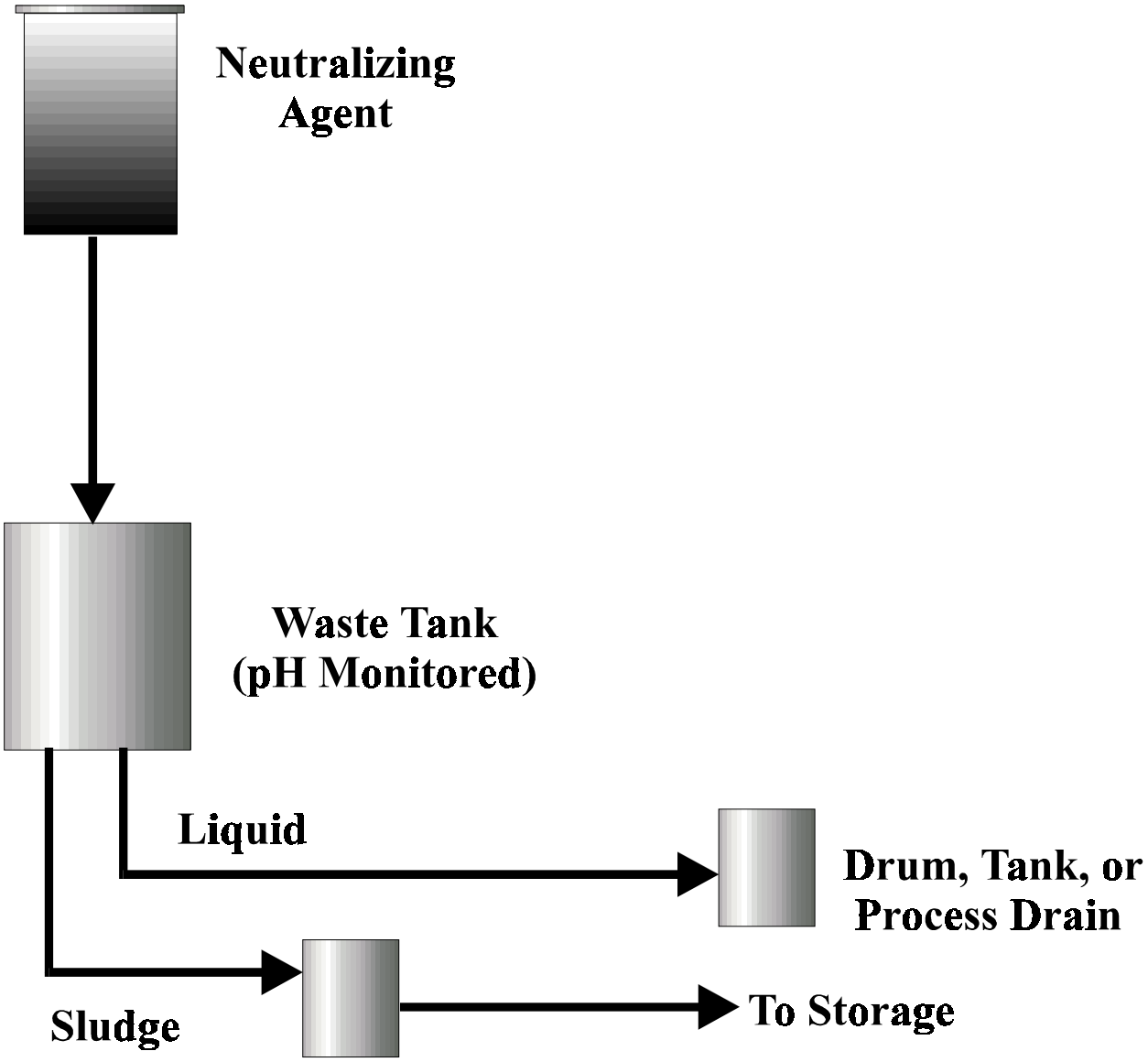


Thermoplastic Resin Variation

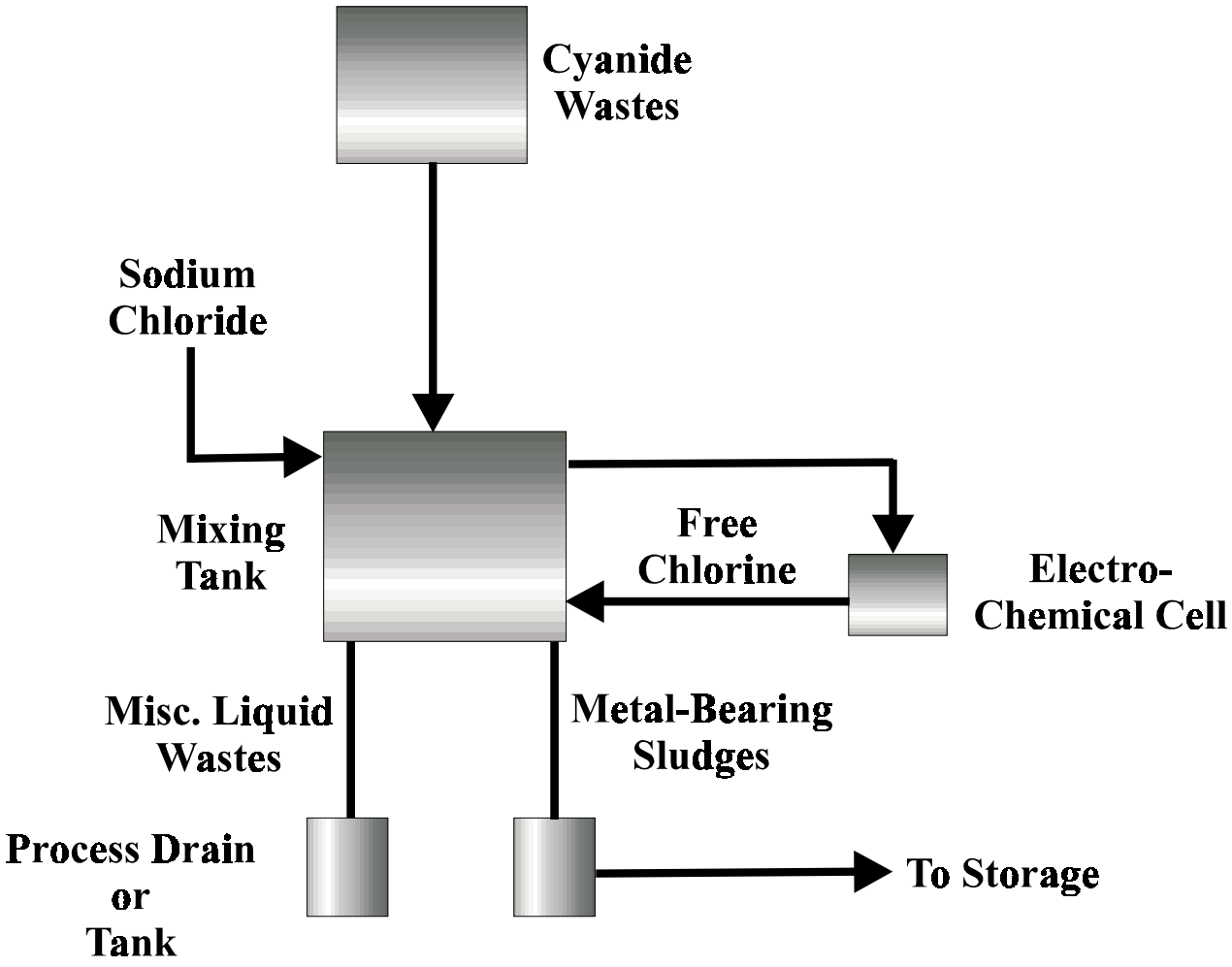
STABILIZATION/IMMOBILIZATION – POLYMER MICROENCAPSULATION



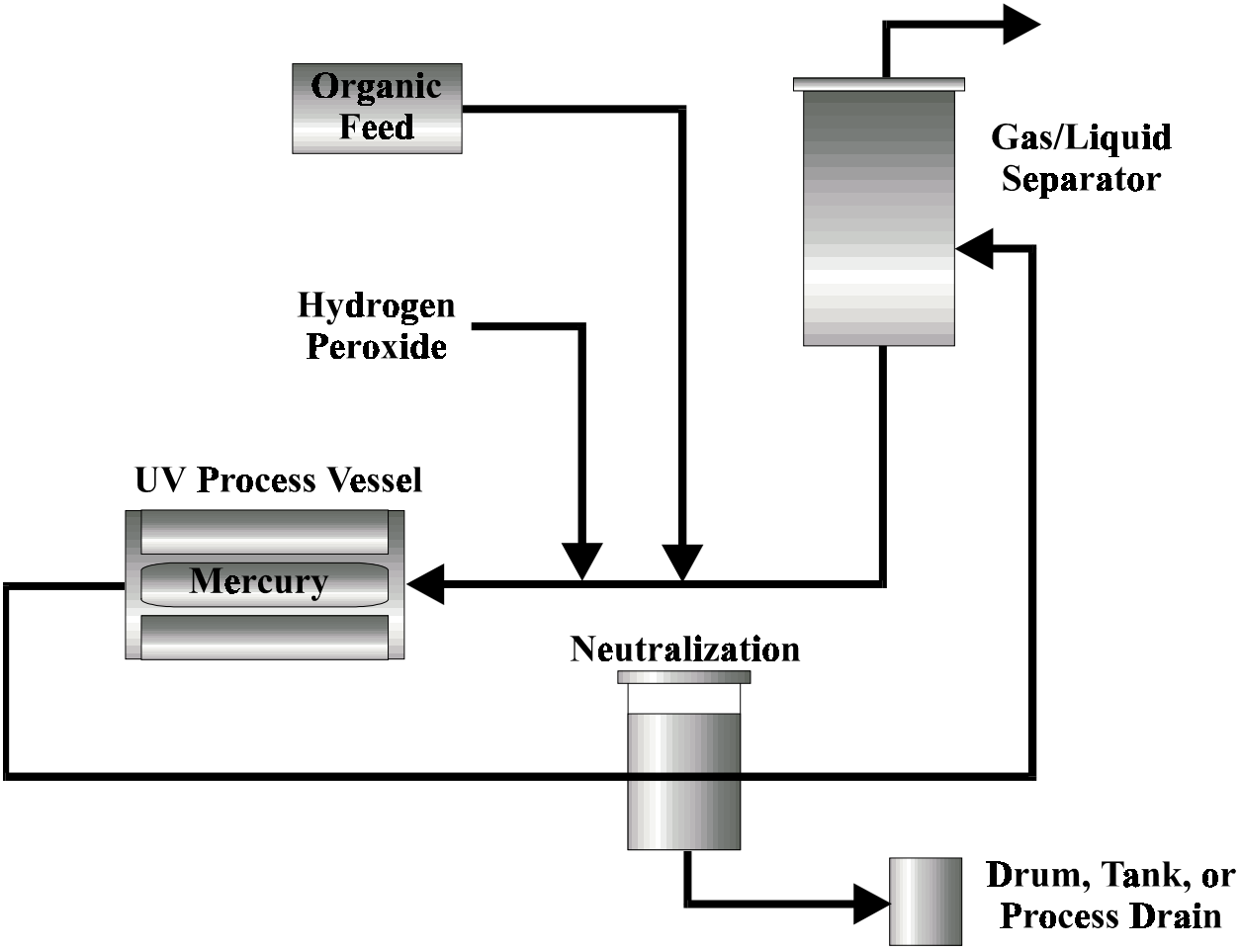
STABILIZATION/IMMOBILIZATION - CEMENTATION



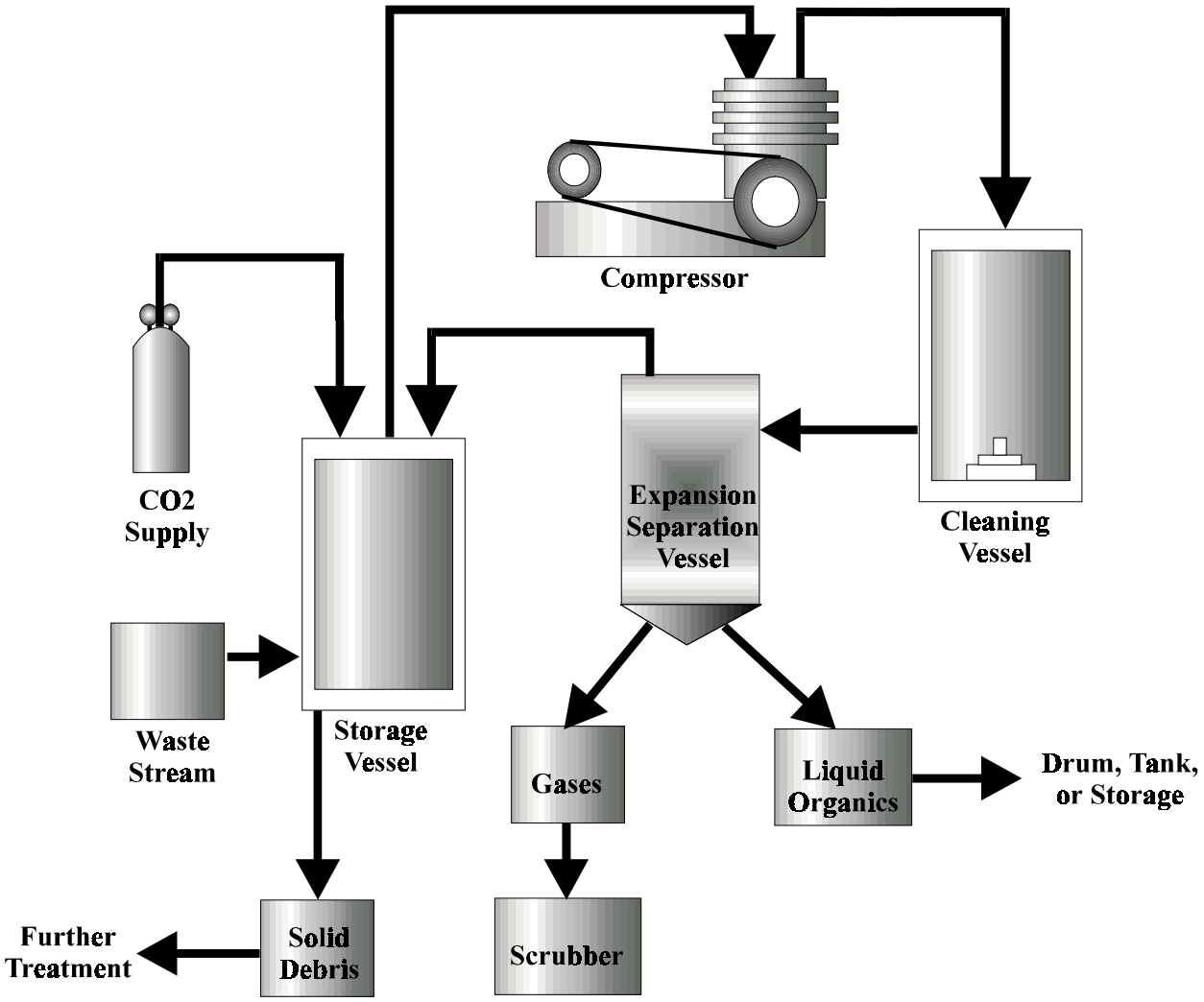
NEUTRALIZATION



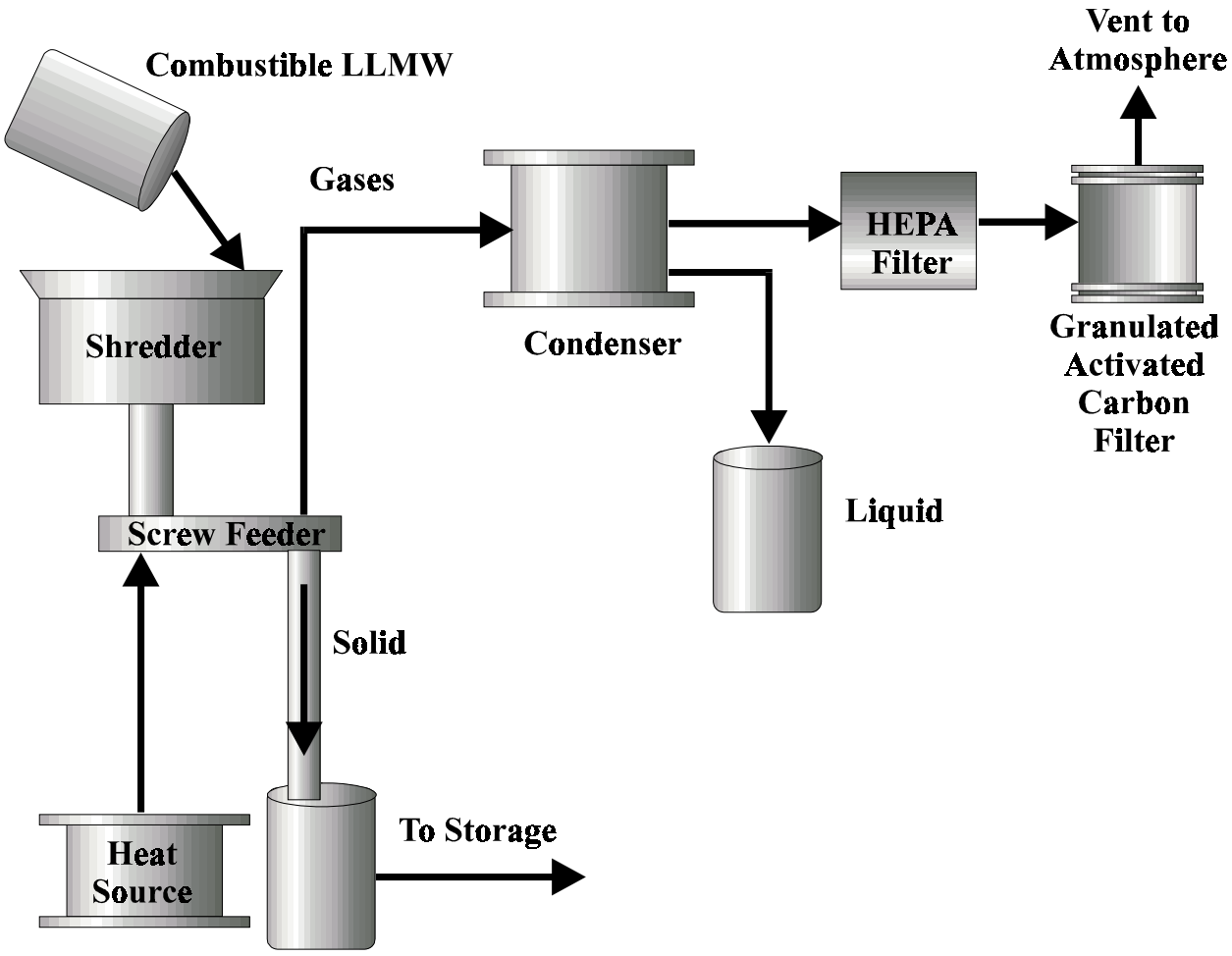
DESTRUCTION – ALKALINE CHLORINATION OF CYANIDES



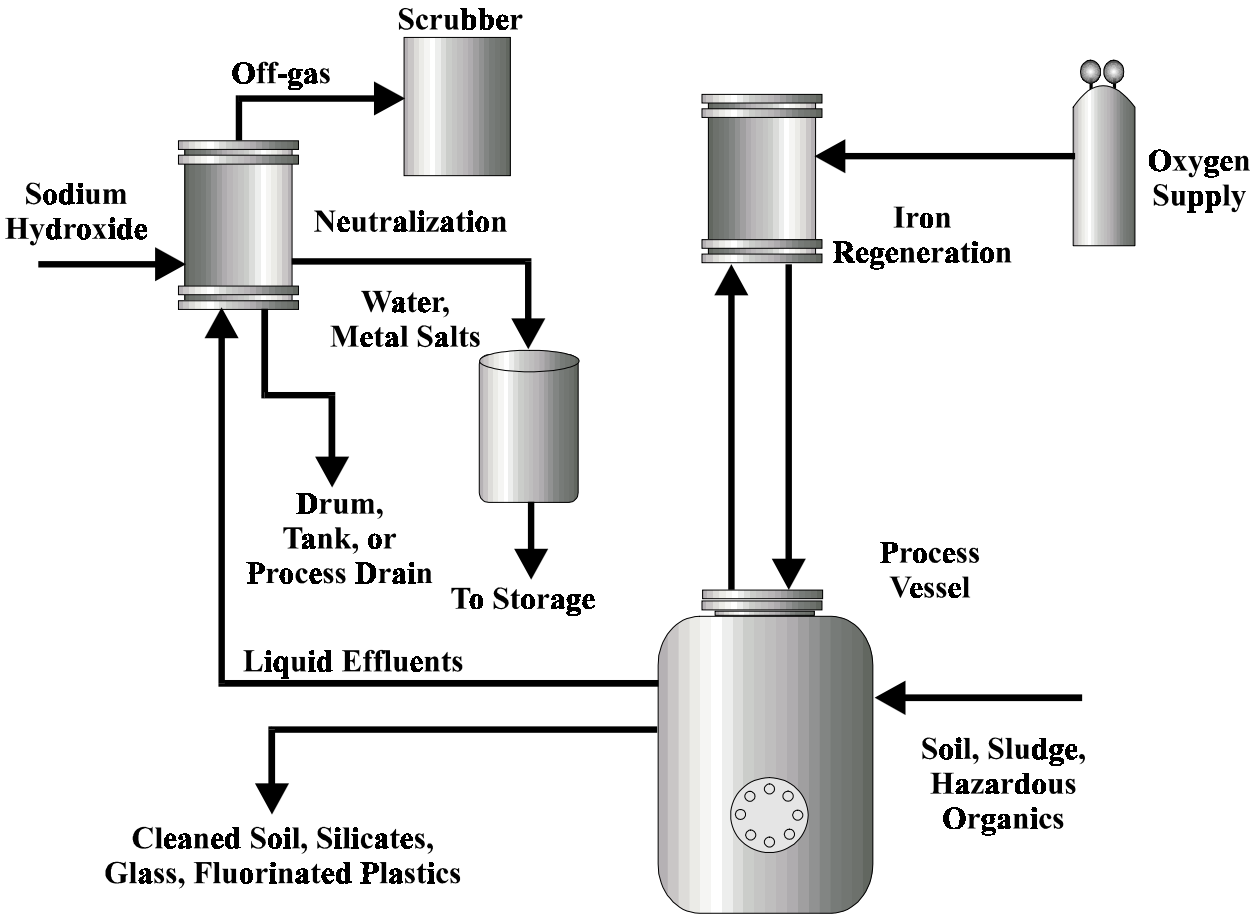
DESTRUCTION – ULTRAVIOLET (UV) OXIDATION



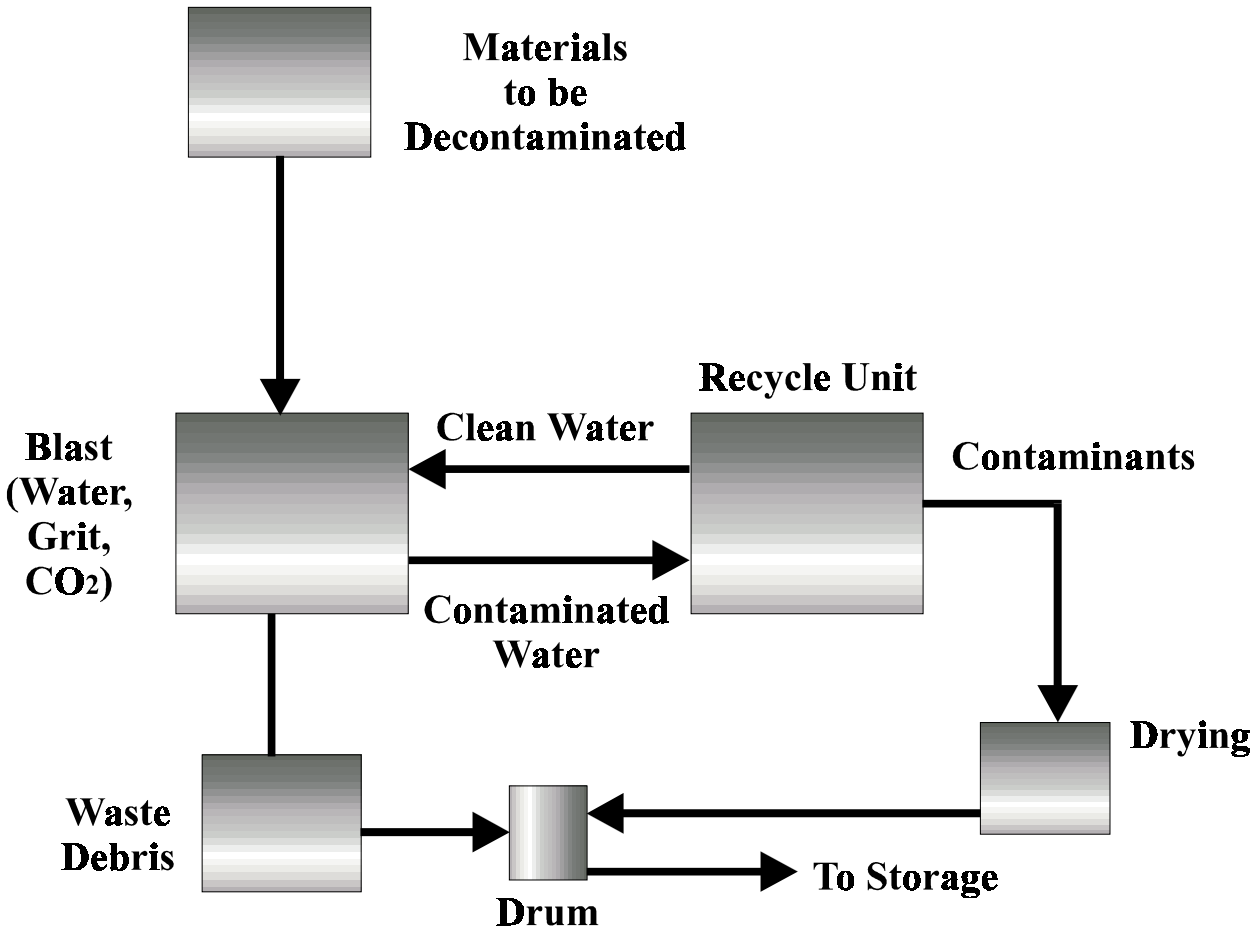
SEPARATION/DECONTAMINATION – SUPERCRITICAL CO2 EXTRACTION



SEPARATION/DECONTAMINATION – LOW TEMPERATURE THERMAL DESORPTION



SEPARATION/DECONTAMINATION – CATALYZED CHEMICAL OXIDATION



SURFACE DECONTAMINATION

Air Quality Management
Air Quality Impacts Analysis for Treatment Technologies Associated with Low-Level Mixed Waste Treatment at the Rocky Flats Environmental Technology Site

1.0 Introduction

The DOE proposes to construct and operate new systems for the treatment of miscellaneous LLMW at the Site. As part of the NEPA Environmental Assessment process, Air Quality Management (AQM) has performed an analysis of regulated air pollutant emissions from each of the proposed treatment technologies. The possible treatment processes include cementation, polymer macroencapsulation, polymer microencapsulation, neutralization, alkaline chlorination of cyanides, ultraviolet oxidation, low temperature thermal desorption, supercritical carbon dioxide extraction, catalyzed chemical oxidation, and surface decontamination.

AQM analyzed each technology based on conservative, bounding assumptions derived from available project information. Potential annual air pollutant emissions from each technology were estimated to determine potential impacts expected from the treatment of LLMW. In order to bound potential air pollutant emissions from the proposed treatment technologies, AQM assumed that all of the technologies would operate concurrently within an enclosure, and all would exhaust to a common vent.

2.0 Non-radionuclide Air Quality Impacts Analysis

Immobilization Technologies: Cementation, Polymer Macroencapsulation, and Polymer Microencapsulation

Assumptions:

1. All three immobilization technologies will run concurrently.

2. There will be limited size reduction requirements.

3. A particulate emission factor of 0.41 kilograms (kg)/metric ton of waste stabilized will be utilized (from "Procedures for Estimating Emissions From Cleanup of Superfund Sites", *Journal of Air and Waste Management Association*, Volume 40, no. 1, p. 19).

4. Due to the low temperatures of the immobilization processes, all arsenic (As), beryllium (Be), cadmium (Cd), chromium (Cr), lead (Pb), and mercury (Hg) emissions will be in the form of particulates.

5. Due to the low temperatures of the immobilization processes, there is insufficient heating to cause thermal decomposition of nitrates and sulfates, and thus, oxides of nitrogen, and

sulfur dioxide emissions will be insignificant (see study titled "On-Line Offgas Analysis of Polymer Solidification Waste Treatment", May 1994).

6. Air exiting the treatment enclosure will flow through at least two stages of HEPA filters.

7. Each drum contains 200 lb of waste material.

8. Volatile organic compound (VOC) contamination is assumed to be the worst-case average of the results from the Waste Isolation Pilot Plant (WIPP) experimental waste characterization program conducted on applicable waste Item Description Codes (IDCs). All VOCs and semi-VOCs contained in the waste to be immobilized are considered to be regulated VOCs and will be lost to the atmosphere during the immobilization process.

9 Cement particulates from the cementation process will be emitted at a rate of 0.33 lb per ton of cement used (*Compilation of Air Pollutant Emission Factors*, U.S. Environmental Protection Agency, AP-42, Section 8.10).

Potential Air Pollutants:

- Particulate matter and PM_{10};
- As, Be, Cd, Cr, Pb, and Hg in particulate form; and
- VOCs and VOC HAPs.

Particulate Emissions

Process rates:	cementation	240 drums/yr	48,000 lb/yr
	polymer macroencapsulation	480 drums/yr	96,000 lb/yr
	polymer microencapsulation	240 drums/yr	48,000 lb/yr
	Total	960 drums/yr	192,000 lb/yr

192,000 lb/yr waste / 2,204 lb/metric ton = 87.1 metric tons/yr of waste immobilized

0.41 kg particulate emissions/metric ton waste X 87.1 metric tons waste immobilized per year = 35.7 kg particulate emissions per year X 2.2 lb/kg = ***78.6 lb/yr uncontrolled particulate emissions from all three immobilization technologies running concurrently.***

Immobilization technologies will be performed within an enclosure. Air exiting the enclosure will pass through at least two stages of HEPA filters before exhausting to the atmosphere. The two stages of HEPA filters are assumed to have the following removal efficiency:

	Removal Efficiency	Pass Through
Stage 1	99.9%	0.001
Stage 2	99.8%	0.002
Total		2.0 E-06

78.6 lb/yr uncontrolled particulate emissions X 2.0E-06 filter efficiency = ***1.57E-04 lb/yr controlled particulate emissions from all three immobilization technologies running concurrently.***

Cement particulate emissions from the cementation process are based on the emissions factor for cement batching (AP-42, Section 8.10), 0.33 lb of particulate emissions/ton of cement used.

The maximum process rate for the cementation technology will use approximately 24 tons of cement per year. 24 tons/yr cement X 0.33 lb/ton emissions = ***8 lb/yr of particulate emissions, uncontrolled.***

8 lb/yr X 2.0 E-06 (HEPA efficiency) = ***1.6E-05 lb/yr particulate emissions, controlled***.

Significant Environmental Impacts Analysis:

The estimated uncontrolled annual particulate air emissions from all three immobilization processes combined totals 86.6 lb. This does not exceed the regulatory reporting and permitting threshold of 2,000 lb/yr for criteria pollutants (total suspended particulates and PM_{10}). This demonstrates that there is no significant impact to the environment expected from total suspended particulate emissions or PM_{10} emissions from the immobilization technologies.

The waste forms to be immobilized contain small quantities of arsenic, beryllium, cadmium, chromium, lead, mercury, and cyanide in the parts per million (ppm) range. Emissions of these pollutants will be in the form of particulates, and will be small fractions of the estimated total annual particulate air emissions of 86.6 lb. This does not exceed the most stringent regulatory reporting threshold of 250 lb/yr for individual HAPs. This demonstrates that there is no significant impact to the environment expected from emissions of arsenic, beryllium, cadmium, chromium, lead, mercury, or cyanide from the immobilization technologies.

VOCs and VOC HAP Emissions:

The worst-case average head-space gas VOC concentration found in the WIPP experimental waste characterization program was 14,475 ppm by volume (ppmv) carbon tetrachloride (CCl_4), in IDC 801 (solidified organics). This equates to 0.034 lb/drum, assuming 208 L/drum.

208 L/drum
29.97 L/mole = 6.94 moles/drum

153.81 g/mole CCl_4 X 6.94 moles/drum = 1,067.4 g CCl_4

14,475 ppmv CCl_4
10^6 ppmv/volume fraction = 1.4475 E-02 volume fraction CCl_4

1.4475 E-02 volume fraction X 1,067.4 g CCl_4 = 15.45 g/drum CCl_4

15.45 g/drum CCl_4 X 0.0022 lb/g = 0.034 lb/drum CCl_4

or

14,475 ppmv CCl_4 X153.81 g/mole X 208 L/drum
29.97 L/mole X 453.6 g/lb X 10^6 ppmv/volume fraction = 0.034 lb/drum CCl_4

0.034 lb/drum CCl_4 X 960 drums/yr waste = ***32.6 lb/yr CCl_4 emissions uncontrolled.***

Assume all 28 identified VOCs are present in the worst case average concentration of 0.034 lb/drum.

32.6 lb/yr X 28 identified VOCs = ***914.2 lb/yr total VOC emissions uncontrolled.***

VOCs and Semi-VOCs that were present in various concentrations in the waste forms analyzed in the WIPP experimental waste characterization program include:

methanol
trichlorotrifluoroethane
acetone
1,1-dichloroethane
2-butanone (MEK)
1,1,1-trichloroethane
carbon tetrachloride
1,2-dichloroethane
trichloroethene
toluene
chlorobenzene
m,p-xylene
bromoform
1,3,5-trimethylbenzene
ethyl ether
1,1-dichloroethene
methylene chloride
cis-1,2-dichloroethene
chloroform
cyclohexane
benzene
1-butanol
4-methyl-2-pentanone
tetrachloroethene
ethylbenzene
o-xylene
1,1,2,2-tetrachloroethene
1,2,4-trimethylbenzene

Significant Environmental Impacts Analysis:

These compounds were present in all or some of the waste forms in varying concentrations, from the lowest maximum average of 0.11 g/drum of ethyl ether, to the highest maximum average of 15.46 g/drum of carbon tetrachloride in IDC 801 (solidified organics). By assuming that all of the above-listed VOCs and semi-VOCs are present in every drum, in the highest maximum average concentration, and that all VOCs and semi-VOCs are regulated pollutants that will be emitted to the atmosphere, it conservatively bounds potential VOC and VOC HAP emissions from this treatment system. Calculated emissions based on the conservative bounding assumptions did not exceed the most stringent regulatory reporting threshold of 250 lb/yr for individual HAPS, nor the regulatory reporting and permitting threshold of 2,000 lb/yr for criteria pollutants (VOCs). This demonstrates that there is no significant impact to the environment expected from VOC emissions and VOC HAP emissions from this technology.

Neutralization

Assumptions:

1. Nitric acid is a BIN A hazardous air pollutant (HAP), so the most conservative assumption is that all acid being neutralized is nitric acid.

2. Neutralization will be performed on waste acids and waste laboratory solutions that are expected to have a pH range of 2.0 –12.0. AQM assumed that the pH of all waste to be neutralized is 1.0.

3. Based on CDPHE guidance from March 1991, the percent of total acid emissions resulting from heat generated in the neutralization reaction is 15% by weight.

4. The specific gravity of acid solutions is assumed to be 1.0, or 8 pounds per gallon (lb/gal).

Analysis:

The maximum quantity of acidic waste to be treated is 96,000 pounds per year (lb/yr).
96,000 lb/yr X 0.125 gallons per pound (gal/lb) = 12,000 gal/yr waste treated.
12,000 gal X 3.785 liters (L)/gal = 45,420 L/yr waste treated.

Molarity of 1.0 pH nitric acid is 10^{-1} = 0.1 moles/L.

0.1 moles/L X 63.01 molecular weight (grams per mole[g/mole]) = 6.3 g/L nitric acid.

6.3 g/L nitric acid X 45,420 L/yr = 286,146 g/yr nitric acid treated.

286,146 g/yr nitric acid treated X 15% nitric acid emissions = 42,922 g/yr of nitric acid (total acid) emissions.

42,922 g/yr nitric acid emissions X .0022 lb/g = ***94.4 lb/yr nitric acid (total acid) emissions <u>uncontrolled</u> from the neutralization process.***

Significant Environmental Impacts Analysis:

Wastes that will go through the neutralization process are expected to have pHs between 2.0 and 12.0. By assuming that all acid wastes to be neutralized will have a pH of 1.0, and by assuming that they are contaminated with nitric acid, which is the most stringently regulated, calculated emissions of acids from the neutralization process are conservatively bounded. Calculated emissions based on the conservative bounding assumptions did not exceed the most stringent regulatory reporting threshold of 250 lb/yr for HAPs (nitric acid). This demonstrates that there is no significant impact to the environment expected from acid emissions from the neutralization technology.

Alkaline Chlorination of Cyanides

Maximum process rate is only 3 drums/year. Process consists of a mixing tank and an electrochemical cell that converts chloride ions to free chlorine, which in turn reacts with the cyanide to break the C-N bonds. There is a possibility of hydrogen cyanide vapors, but based on the process rate and on the process description, emissions are expected to be negligible. Emissions will not exceed the most stringent regulatory reporting threshold of 250 lb/yr for individual HAPs, and demonstrates that there is no significant impact to the environment expected from this treatment system.

Ultraviolet Oxidation

Maximum process rate is only 120 L/yr. In the process, hydrogen peroxide is pumped into a waste storage vessel containing organics-contaminated liquid waste under an ultraviolet light source. The process is at ambient temperature. Although there will be possible VOC emissions, based on the process rate and on results of a treatability study performed in 1994, emissions are expected to be negligible. Emissions will not exceed the most stringent regulatory reporting threshold of 250 lb/yr for individual HAPs, and demonstrates that there is no significant impact to the environment expected from this treatment system.

Separation/decontamination Treatment Systems

There are three potential separation/decontamination treatment technologies. The two most likely technologies are low temperature thermal desorption and supercritical carbon dioxide extraction. The third technology, catalyzed chemical oxidation, is not likely to be utilized.

1. Maximum process rate for separation/decontamination technologies is 48,000 lb/yr or 240 drums/yr.

2. Size reduction will be required to increase surface area.

3. Due to the low temperatures of the separation/decontamination processes, all arsenic, beryllium, cadmium, chromium, lead, and mercury emissions will be in the form of particulates during size reduction.

4. Due to the low temperatures of the separation/decontamination processes, there is insufficient heating to cause thermal decomposition of nitrates and sulfates, and thus, oxides of nitrogen, and sulfur dioxide emissions will be insignificant.

5. Air exiting the treatment enclosure will flow through at least two stages of HEPA filters.

6. Each drum contains 200 lb of waste material.

7. VOC contamination is assumed to be the worst-case average of the results from the WIPP experimental waste characterization program conducted on applicable IDCs. All VOCs

and semi-VOCs contained in the waste to be immobilized are considered to be regulated VOCs and will be lost to the atmosphere during the immobilization process.

Potential Air Pollutants

- Particulate matter and PM_{10};
- As, Be, Cd, Cr, Pb, and Hg in particulate form; and
- VOCs and VOC HAPs

Particulate Emissions

AP-42 emission factor for bauxite size-reduction is 6.0 lb/ton. Bauxite is more dispersible overall than the waste forms to be size-reduced for separation/decontamination, therefore the 6.0 lb/ton emission factor should conservatively bound the particulate emissions expected from waste size-reduction.

6.0 lb/ton particulate emissions X 24 tons/yr waste size-reduced = ***144 lb/yr uncontrolled particulate emissions from separation/decontamination technologies***

144 lb/yr X 2.0 E-06 (HEPA efficiency) = ***2.88 E-04 lb/yr controlled particulate emissions***.

Significant Environmental Impacts Analysis:

Utilization of a conservative particulate emission factor for all waste forms, and assuming that all waste will be size-reduced conservatively bounds potential particulate air pollutant emissions from these processes. The estimated uncontrolled annual particulate air emission from the separation/decontamination technologies is 144 lb. This does not exceed the regulatory reporting and permitting threshold of 2,000 lb/yr for criteria pollutants (total suspended particulates and PM_{10}). This demonstrates that there is no significant impact to the environment expected from total suspended particulate emissions or PM_{10} emissions from the separation/decontamination technologies.

The waste forms to be immobilized contain small quantities of arsenic, beryllium, cadmium, chromium, lead, mercury, and cyanide (ppm range). Emissions of these pollutants will be in the form of particulates, and will be small fractions of the estimated total annual particulate air emissions of 144 lb. This does not exceed the most stringent regulatory reporting threshold of 250 lb/yr for individual HAPs, and demonstrates that there is no significant impact to the environment expected from emissions of arsenic, beryllium, cadmium, chromium, lead, mercury, or cyanide from the separation/decontamination technologies.

VOC and VOC HAP Emissions:

The worst-case average head-space gas VOC concentration found in the WIPP experimental waste characterization program was 14,475.3 ppmv of CCl_4 in IDC 801 (solidified organics). This equates to 15.46 g/drum, assuming 208 L/drum.

208 L/drum
29.97 L/mole = 6.94 moles/drum

153.81 g/mole CCl_4 X 6.94 moles/drum = 1,067.4 g CCl_4

14,475 ppmv CCl_4
10^6 ppmv/volume fraction = 1.4475 E-02 volume fraction CCl_4

1.4475 E-02 volume fraction X 1,067.4 g CCl_4 = 15.45 g/drum CCl_4

15.45 g/drum CCl_4 X 0.0022 lb/g = 0.034 lb/drum CCl_4

or

14,475 ppmv CCl_4 X153.81 g/mole X 208 L/drum
29.97 L/mole X 453.6 g/lb X 10^6 ppmv/volume fraction = 0.034 lb/drum CCl_4

0.034 lb/drum CCl_4 X 240 drums/yr waste = ***8.16 lb/yr CCl_4 emissions uncontrolled***

Assume all 28 identified VOCs are present in the worst case average concentration of 0.034 lb/drum.

8.16 lb/yr X 28 identified VOCs = ***228.5 lb/yr total VOC emissions uncontrolled***

VOCs and semi-VOCs that were present in various concentrations in the waste forms analyzed in the WIPP experimental waste characterization program include:

Methanol	ethyl ether
Trichlorotrifluoroethane	1,1-dichloroethene
Acetone	methylene chloride
1,1-dichloroethane	cis-1,2-dichloroethene
2-butanone (MEK)	chloroform
1,1,1-trichloroethane	cyclohexane
carbon tetrachloride	benzene
1,2-dichloroethane	1-butanol
Trichloroethene	4-methyl-2-pentanone
Toluene	tetrachloroethene
Chlorobenzene	ethylbenzene
m,p-xylene	o-xylene
Bromoform	1,1,2,2-tetrachloroethene
1,3,5-trimethylbenzene	1,2,4-trimethylbenzene

Significant Environmental Impacts Analysis:

These compounds were present in all or some of the waste forms in varying concentrations, from the lowest maximum average of 0.11 g/drum of ethyl ether, to the highest maximum average of

15.46 g/drum of carbon tetrachloride in IDC 801 (solidified organics). By assuming that all of the above-listed VOCs and semi-VOCs are present in every drum, in the highest maximum average concentration, and that all VOCs and semi-VOCs are regulated pollutants that will be emitted to the atmosphere, it conservatively bounds potential VOC and VOC HAP emissions from this treatment system. Calculated emissions based on the conservative bounding assumptions did not exceed the most stringent regulatory reporting threshold of 250 lb/yr for individual HAPs, nor the regulatory reporting and permitting threshold of 2,000 lb/yr for criteria pollutants (VOCs). This demonstrates that there is no significant impact to the environment expected from VOC emissions and VOC HAP emissions from this technology.

Surface Decontamination

Surface decontamination will be performed on debris materials only. Particulates and PM_{10} are the potential regulated air pollutants of concern. There are three potential processes proposed for surface decontamination: grit blasting, carbon dioxide pellet blasting, and high pressure water sprays. The process will be conducted in a contained enclosure with at least two stages of HEPA filters. The process with the greatest potential to produce air emissions is grit blasting. AQM assumed that all surface decontamination will be performed utilizing this technology.

A maximum of 96,000 lb/yr of debris waste will go through the surface decontamination process. A particulate emission factor of 27 lb/1,000 lb of abrasive will be utilized for this estimate (AP-42, Section 13.2.6, Abrasive Blasting). This emission factor is based on outdoor sand blasting with a 5 miles per hour (mph) wind, which is much more conservative than grit blasting conducted indoors with no wind factor. According to process personnel, there will be approximately five drums per year of waste grit generated from the grit blasting process. Based on the 27 lb emissions/1,000 lb of abrasive, the five waste drums will contain 97.3% of the total grit used in the process.

The specific gravity of Blackhawk Slag Products grit is 3.41 (MSDS).

5 drums grit = 275 gal X 8 lb/gal X 3.41 specific gravity = 7,502 lb/yr of grit waste.

7502 lb/yr grit waste
0.973 total grit fraction = 7,710 lb/yr total grit usage

7,710 lb/yr total grit usage – 7,502 lb/yr grit waste = 208 lb/yr of uncontrolled grit particulate emissions to the atmosphere.

208 lb/yr particulate emissions X 2.0E-06 HEPA filter efficiency = 4.16E-04 lb/yr controlled particulate emissions.

Significant Environmental Impacts Analysis

Utilization of a conservative sand blasting particulate emission factor and the assumption that grit blasting will be the technology utilized for all surface decontamination conservatively

bounds potential particulate air pollutant emissions from the process. Uncontrolled particulate air emissions from surface decontamination based on the above listed conservative assumptions are estimated to be 208 lb/yr. This does not exceed the regulatory reporting and permitting threshold of 2,000 lb/yr for criteria pollutants (total suspended particulates and PM_{10}). This demonstrates that there is no significant impact to the environment expected from total suspended particulate emissions or PM_{10} emissions from the surface decontamination technologies.

The debris waste forms to be decontaminated may contain small quantities of arsenic, beryllium, cadmium, chromium, lead, mercury, and cyanide (ppm range). Also, grit used in the grit blasting process may contain small quantities of hazardous particulate metals. Emissions of these pollutants will be in the form of particulates, and will be small fractions of the estimated total annual particulate air emissions of 208 lb. This does not exceed the most stringent regulatory reporting threshold of 250 lb/yr for individual HAPs, and demonstrates that there is no significant impact to the environment expected from emissions of arsenic, beryllium, cadmium, chromium, lead, mercury, cyanide, and other hazardous metals from the surface decontamination technologies.

Combined estimated emissions of uncontrolled non-radionuclide air pollutants from the LLMW treatment technologies will not exceed the most stringent regulatory reporting threshold of 250 lb/yr for individual HAPs, nor the 2,000 lb/yr permitting and reporting threshold for criteria pollutants, and demonstrates that there is no significant impact to the environment expected from the proposed treatment of LLMW at the Rocky Flats Environmental Technology Site.

Cumulative Environmental Impacts Analysis For Non-radionuclide Air Pollutant Emissions

Technology	Uncontrolled TSP/ PM_{10} Emissions lb/yr	Uncontrolled VOC Emissions lb/yr	Uncontrolled VOC/HAP Emissions lb/yr	Uncontrolled Acid HAP Emissions lb/yr
Neutralization	--------	112	4	94
Immobilization	87	914	33	--------
Separation/decontamination	144	228	8	--------
Surface Decon.	208	--------	--------	--------
Total Emissions	**439**	**1,254**	**45**	**94**
Regulatory Permitting or Reporting Thresholds	2,000 lb/yr	2,000 lb/yr	250 lb/yr for most stringently regulated HAP	250 lb/yr for most stringently regulated HAP

3.0 Radionuclide Air Quality Impacts Analysis

Treatment of LLMW has the potential for radionuclide air emissions. LLMW is waste contaminated with transuranic elements at a level of specific activity less than 100 nanocuries per gram (nCi/g) or wastes contaminated with uranium. For the radionuclide air quality impacts analysis, AQM assumed that all LLMW to be treated is contaminated at the maximum low-level specific activity of 100 nCi/g plutonium-239 (Pu-239). This assumption conservatively bounds potential radionuclide emissions from the LLMW treatment technologies.

Assumptions:

1. Cementation, macroencapsulation, microencapsulation, neutralization, alkaline chlorination of cyanides, ultraviolet oxidation, and separation/decontamination will occur concurrently in the same location and will exhaust to the same vent. Surface decontamination will not occur in the same location as the other treatment technologies.

2. LLMW treatment technologies will occur in a radioactive control enclosure with at least two stages of HEPA filters.

3. LLMW treatment technologies will operate an average of 1 shift per day, 5 days per week, 35 weeks per year.

Cementation

Same process parameters as microencapsulation = **1.98E-03 Ci/yr**

Macroencapsulation

Maximum quantity of waste to be treated per year is 96,000 lb. Process rate is 1 shift/day, 5 days/week, 35 weeks/year = 96,000 lb/yr / 175 process days/yr = 549 lb/day processed

Process rate: 549 lb/day X 453.59 g/lb X 100 nCi/g X 1E-09 Ci/nCi = 0.0249 Ci/day

$$\frac{0.0249 \text{ Ci/day} \times 8 \text{hrs/day} \times 175 \text{ days/yr}}{24 \text{hrs/day} \times 365 \text{ days/yr}} = \mathbf{3.98E\text{-}03\ Ci/yr}$$

Microencapsulation

Maximum quantity of waste to be treated per year is 48,000 lb. Process rate is 1 shift/day, 5 days/week, 35 weeks/year = 48,000 lb/yr / 175 process days/yr = 274. lb/day processed

Process rate: 274 lbs/day X 453. 59 g/lb X 100 nCi/g X 1E-09 Ci/nCi = 1.24E-02 Ci/day

0.0124 Ci/day X 8hrs/day X 175 days/yr
24hrs/day X 365 days/yr = **1.98E-03 Ci/yr**

Neutralization

Same process parameters as macroencapsulation = **3.98E-03 Ci/yr**

Alkaline chlorination of cyanides

Process rate: 165 gal/yr
175 days/yr =0.943 gal/day X 128 ounces (oz)/gal X 1.5 spec. grav. X 0.0625 lb/oz
= 11.3 lb/day processed

11.3 lb/day X 453 g/lb X 100nCi/g X 1E-09 Ci/nCi = 5.13 E-04 Ci/day

5.13E-04 Ci/day X 8hrs/day X 175 days/yr
24hrs/day X 365 days/yr = **8.2E-05 Ci/yr**

Ultraviolet Oxidation

Process rate: 2 lb waste/day X 453.59 g/lb X 100 nCi/g X 1E-09 Ci/nCi = 9.07E-05 Ci/day

9.07E-05 Ci/day X 8hrs/day X 175 days/yr
24hrs/day X 365 days/yr = **1.45E-05 Ci/yr**

Separation/decontamination

Same process parameters as microencapsulation = **1.98E-03 Ci/yr**

Surface Decontamination (emission factor of 1)

96,000 lb/yr X 453 g/lb X 100 nCi/g X 1E-09 Ci/nCi = **4.35 Ci/yr**

Radionuclide Air Emissions Summary

Treatment Technology	Ci/yr
cementation	1.98E-03
polymer macroencapsulation	3.98E-03
polymer microencapsulation	1.98E-03
neutralization	3.98E-03

alkaline chlorination of cyanides	8.20E-05
ultraviolet oxidation	1.45E-05
Separation/decontamination	1.98E-03
Total	1.4E-02

1.4E-02 Ci/yr X 1E-03 emission factor = ***1.4E-05 Ci/yr uncontrolled (CAP88PC input)***

Surface decontamination = ***4.35 Ci/yr uncontrolled (CAP88PC input)***

CAP88PC results:

Cementation, macroencapsulation, microencapsulation, neutralization, separation/ decontamination, UV oxidation, and alkaline chlorination of cyanide treatment systems running concurrently and all exhausting to the same vent:

4.5E-04 millirem per year (mrem/yr) effective dose equivalent (EDE) to the MEI, uncontrolled.

4.5E-08 mrem/yr EDE to MEI, controlled (based on two stages of HEPA filters).

Surface decontamination treatment system running separately and exhausting to a separate vent:

140 mrem/yr EDE to MEI, uncontrolled (requires continuous radionuclide air monitoring)

0.014 mrem/yr EDE to MEI, controlled (based on two stages of HEPA filters)

Significant Environmental Impacts Analysis:

The National Emission Standard for Hazardous Air Pollutants (NESHAP) for radionuclides from DOE facilities is defined in 40 CFR 61, Subpart H, Section 61.93. It states that "emissions of radionuclides to the ambient air from Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an EDE of 10 mrem/yr." The estimated EDE to the most impacted public receptor resulting from controlled radionuclide emissions from all of the LLMW treatment technologies combined is 0.014 mrem/yr. The total EDE to the most impacted public receptor from the entire Rocky Flats Environmental Technology Site for calendar year 1997 was 0.128 mrem (as measured at the Site boundary). Thus, the estimated 0.014 mrem/yr EDE from the LLMW treatment technologies will not impact the 10 mrem standard, and is not expected to have a significant impact on the environment.